

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FLUIDMASTER, INC.
Petitioner

v.

DANCO, INC.
Patent Owner

Case No.: IPR2024-00634
U.S. Patent No. 9,103,105 B2

DECLARATION OF DR. KIMBERLY CAMERON

TABLE OF CONTENTS

TABLE OF CONTENTS.....	i
LIST OF REPORT APPENDICES AND EXHIBITS	viii
I. INTRODUCTION	- 1 -
II. EDUCATION AND WORK EXPERIENCE	- 1 -
III. SCOPE OF WORK	- 5 -
IV. DOCUMENTS RELIED ON	- 6 -
V. SUMMARY OF OPINIONS.....	- 6 -
VI. RELEVANT LEGAL PRINCIPLES AND GUIDELINES.....	- 7 -
A. LEVEL OF SKILL	- 7 -
B. CLAIM CONSTRUCTION	- 8 -
1. “Integrally Molded”	- 12 -
2. “Bowl Fill Restriction”	- 14 -
C. PRIOR ART AND PRIORITY DATE FOR THE ’105 PATENT	- 16 -
D. ANTICIPATION.....	- 18 -
E. OBVIOUSNESS	- 18 -
VII. BACKGROUND AND OVERVIEW OF THE ’105 PATENT	- 24 -
A. TECHNOLOGICAL BACKGROUND.....	- 24 -
B. PURPORTED INVENTION OF THE ’105 PATENT.....	- 31 -
C. SUMMARY OF THE PROSECUTION HISTORY OF THE ’105 PATENT.....	- 32 -
D. SUMMARY OF THE PROSECUTION HISTORIES OF THE RELATED PATENTS	- 33 -
VIII. VALIDITY ANALYSIS OF THE CHALLENGED CLAIMS	- 33 -
A. BRIEF OVERVIEW OF THE PRIOR ART REFERENCES	- 34 -
1. Registered Utility Model Publication Number CN2447417Y to Guoxin (“Guoxin”)	- 34 -
2. U.S. Patent No. 3,086,546 to Brown (“Brown”)	- 34 -
3. U.S. Patent No. 8,104,105 to Schuster et al. (“Schuster”)...	- 35 -
4. U.S. Patent No. 5,862,538 to Ho (“Ho”)	- 35 -

5.	U.S. Patent No. 5,926,868 to Bjerke (“Bjerke”).....	- 35 -
6.	U.S. Patent No. 5,249,830 to Calmettes, et al. (“Calmettes”).....	- 35 -
7.	U.S. Patent No. 989,251 to Hall (“Hall”)	- 36 -
8.	Canadian Patent No. 1,320,235 to Kimber (“Kimber”).....	- 36 -
B.	Claims 1-3, 6, 8-15, and 20-24 Are Obvious Under 35 U.S.C. §103 Over Guoxin in View of Ho	- 36 -
1.	Independent Claims 1 and 24 Are Obvious Over Guoxin in View of Ho	- 41 -
a)	Claim Elements 1[Pre], 24 [Pre]	- 44 -
b)	Claim Elements 1[A], 24 [A]	- 44 -
c)	Claim Elements 1[B], 24[B]	- 46 -
d)	Claim Elements 1[C], 24[C]	- 47 -
e)	Claim Elements 1[D1], 24[D1]	- 48 -
f)	Claim Element 1[D2]	- 49 -
g)	Claim Element 24[D2]	- 52 -
h)	Claim Elements 1[D3], 24[D3]	- 53 -
i)	Claim Elements 1[D4], 24[D4]	- 55 -
j)	Claim Elements 1[E], 24[E]	- 56 -
k)	Summary of Opinions Regarding Independent Claims 1 and 24- 58 -	
2.	Independent Claim 9 is Obvious Over Guoxin in View of Ho ..	- 59 -
a)	Claim Elements 9[Pre], 9[A]	- 59 -
b)	Claim Element 9[B]	- 60 -
c)	Claim Element 9[C1]	- 61 -
d)	Claim Element 9[C2]	- 62 -
e)	Claim Element 9[C3]	- 63 -
f)	Claim Element 9[C4]	- 64 -
g)	Claim Element 9[C5]	- 65 -

h)	Claim Element 9[D]	- 65 -
i)	Summary of Opinions Regarding Independent Claim 9.....	- 66 -
3.	Independent Claim 15 is Obvious Over Guoxin in View of Ho	- 66 -
a)	Claim Element 15[Pre]	- 67 -
b)	Claim Element 15[A1]	- 67 -
c)	Claim Element 15[A2]	- 68 -
d)	Claim Element 15[B]	- 68 -
e)	Claim Element 15[C]	- 68 -
f)	Summary of Opinions Regarding Independent Claim 15....	- 69 -
4.	Dependent claims 2-3, 6, 8, 10-14, and 16-23 are Obvious	- 69 -
a)	Claim 2	- 69 -
b)	Claim 3	- 69 -
c)	Claim 6	- 70 -
d)	Claim 8	- 72 -
e)	Claim 10	- 72 -
f)	Claims 11 and 12.....	- 73 -
g)	Claims 13 and 14.....	- 74 -
h)	Claim 20	- 74 -
i)	Claims 21 and 23.....	- 75 -
j)	Claim 22	- 75 -
C.	Dependent Claims 4, 5, 7, and 16-19 Are Obvious Under 35 U.S.C. §103 Over Guoxin in view of Ho, and Further in View of the Quick Connection Art	- 76 -
1.	Claims 4 and 5.....	- 76 -
2.	Claim 7	- 83 -
3.	Claims 16-19	- 83 -
D.	Claims 1-3, 6, 8-15, and 20-24 Are Obvious Under 35 U.S.C. §103 Over Brown in View of Ho	- 86 -

1.	Independent Claims 1 and 24 Are Obvious Over Brown in View of Ho.....	- 88 -
2.	Claim Elements 1[Pre], 24 [Pre].....	- 88 -
3.	Claim Elements 1[A], 24 [A].....	- 90 -
4.	Claim Elements 1[B], 24[B]	- 91 -
5.	Claim Elements 1[C], 24[C]	- 92 -
6.	Claim Elements 1[D1], 24[D1].....	- 93 -
7.	Claim Element 1[D2].....	- 94 -
8.	Claim Element 24[D2]	- 95 -
9.	Claim Elements 1[D3], 24[D3].....	- 96 -
10.	Claim Elements 1[D4], 24[D4].....	- 97 -
11.	Claim Elements 1[E], 24[E].....	- 98 -
12.	Summary of Opinions Regarding Independent Claims 1 and 24-100 -	
13.	Independent Claim 9 is Obvious Over Brown in View of Ho.... -100 -	
14.	Claim Elements 9[Pre], 9[A]	- 101 -
15.	Claim Element 9[B]	- 101 -
16.	Claim Element 9[C1]	- 101 -
17.	Claim Element 9[C2]	- 102 -
18.	Claim Element 9[C3]	- 102 -
19.	Claim Element 9[C4]	- 103 -
20.	Claim Element 9[C5]	- 103 -
21.	Claim Element 9[D].....	- 104 -
22.	Summary of Opinions Regarding Independent Claim 9.... -104 -	
23.	Independent Claim 15 is Obvious Over Brown in View of Ho.. -104 -	
24.	Claim Element 15[Pre]	- 105 -
25.	Claim Element 15[A1].....	- 105 -
26.	Claim Element 15[A2].....	- 105 -

27.	Claim Element 15[B]	- 106 -
28.	Claim Element 15[C]	- 106 -
29.	Summary of Opinions Regarding Independent Claim 15..	- 107 -
30.	Dependent Claims 2-3, 6, 8, 10-14, and 16-23 are Obvious -	107 -
a)	Claim 2	- 107 -
b)	Claim 3	- 108 -
c)	Claim 6	- 108 -
d)	Claim 8	- 109 -
e)	Claim 10	- 110 -
f)	Claims 11 and 12	- 110 -
g)	Claims 13 and 14	- 111 -
h)	Claim 20	- 111 -
i)	Claims 21 and 23	- 112 -
j)	Claim 22	- 112 -
E.	Dependent Claims 4, 5, 7, and 16-19 Are Obvious Under 35 U.S.C. §103 Over Brown in view of Ho, and Further in View of the Quick Connection Art	- 113 -
1.	Claim 4	- 113 -
2.	Claim 5	- 116 -
3.	Claim 7	- 117 -
4.	Claims 16-19	- 117 -
F.	Claims 1-24 Are Anticipated By Schuster	- 119 -
1.	Patent Owner Will Not Be Able to Meet Its Burden of Production to Show Entitlement to Its Priority Applications	- 120 -
2.	Independent Claims 1 and 24 are Anticipated by Schuster .	- 125 -
a)	1[Pre], 24[Pre]	- 125 -
b)	1[A], 24[A]	- 126 -
c)	Claim Elements 1[B], 24[B]	- 127 -

d)	Claim Elements 1[C], 24[C]	- 127 -
e)	Claim Elements 1[D1], 24[D1].....	- 128 -
f)	Claim Element 1[D2]	- 128 -
g)	Claim Element 24[D2]	- 129 -
h)	Claim Elements 1[D3], 24[D3].....	- 129 -
i)	Claim Elements 1[D4], 24[D4].....	- 130 -
j)	Claim Elements 1[E], 24[E].....	- 131 -
3.	Independent Claim 9 is Anticipated by Schuster.....	- 131 -
a)	Claim Elements 9[Pre], 9[A]	- 131 -
b)	Claim Element 9[B]	- 132 -
c)	Claim Element 9[C1]	- 132 -
d)	Claim Element 9[C2]	- 132 -
e)	Claim Element 9[C3]	- 133 -
f)	Claim Element 9[C4]	- 133 -
g)	Claim Element 9[C5]	- 133 -
h)	Claim Element 9[D]	- 133 -
4.	Independent Claim 15 is Anticipated by Schuster.....	- 134 -
a)	Claim Element 15[Pre]	- 135 -
b)	Claim Element 15[A1]	- 135 -
c)	Claim Element 15[A2]	- 135 -
d)	Claim Element 15[B]	- 136 -
e)	Claim Element 15[C]	- 136 -
5.	Summary of Opinions Regarding Claims 1, 9 15, and 24.-	- 136 -
6.	Dependent Claims 2-8, 10-14, and 16-23 are Anticipated by Schuster	- 137 -
a)	Claim 2	- 137 -
b)	Claim 3	- 137 -
c)	Claims 4 and 5.....	- 137 -
d)	Claim 6	- 138 -

e)	Claim 7.....	- 139 -
f)	Claim 8.....	- 140 -
g)	Claim 10.....	- 140 -
h)	Claims 11 and 12.....	- 140 -
i)	Claims 13 and 14.....	- 141 -
j)	Claims 16-18.....	- 141 -
k)	Claim 19.....	- 142 -
l)	Claim 20.....	- 143 -
m)	Claims 21 and 23.....	- 143 -
n)	Claim 22.....	- 144 -
IX.	MOTIVATION TO COMBINE REFERENCES.....	- 144 -
X.	SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS	- 146 -
XI.	CONCLUDING REMARKS	- 146 -

LIST OF REPORT APPENDICES AND EXHIBITS

Appendix	Description
A	Curriculum Vitae of Kim Cameron
B	Excerpt from ASSE International Plumbing Dictionary 6 th Edition

Exhibit No.	Description
EX1001	U.S. Patent No. 9,103,105 to Schuster et al.
EX1002	Prosecution History of U.S. Patent No. 9,103,105 (Application No. 14/457,697 filed August 12, 2014)
EX1003	Complaint (Dkt. 1) in Danco, Inc. v. Fluidmaster, Inc., et al., Case No. 8:23-cv-01156 (C.D. Cal.), filed June 28, 2023
EX1005	U.S. Patent No. 10,934,698 to Schuster et al.
EX1006	Prosecution History of U.S. Patent No. 10,934,698 to Schuster et al. (Application No. 16/686,328, filed March 2, 2021)
EX1007	U.S. Patent No. 9,139,993 to Schuster et al.
EX1008	Prosecution History of U.S. Patent No. 9,139,993 to Schuster et al. (Application No. 14/164,424, filed January 27, 2014)
EX1009	Prosecution History of U.S. Patent No. 8,650,671 to Schuster et al. (Application No. 13/346,355, filed January 9, 2012)
EX1010	Prosecution History of U.S. Patent No. 8,104,105 to Schuster et al. (Application No. 12/786,904, filed on May 25, 2010)
EX1011	Prosecution History of U.S. Patent No. 7,743,436 to Schuster et al. (Application No. 10/958,797, filed October 5, 2004)
EX1012	Prosecution History of U.S. Patent No. 6,823,889 to Schuster (Application No. 10/798,606, filed on Mar. 11, 2004)
EX1013	Amended Complaint (Dkt. 35) in Danco, Inc. v. Fluidmaster, Inc., et al., Case No. 8:23-cv-01156 (C.D. Cal.), filed October 2, 2023
EX1014	U.S. Patent No. 6,546,568 B1 to Schuster issued April 15, 2003 from Application No/ 09/969,320 filed October 1, 2001, as a continuation of Application No. 09/634,249 filed August 8, 2000 (now U.S. Patent No. 6,295,660)
EX1015	Registered Utility Model Publication Number CN2447417Y to Guoxin published September 12, 2001
EX1016	Certified Translation (together with a statement that the translation is true and accurate) of Registered Utility Model Publication Number CN2447417Y to Guoxin published September 12, 2001
EX1017	U.S. Patent No. 5,926,868 to Bjerke issued July 27, 1999
EX1018	U.S. Patent No. 5,249,830 to Calmettes, et al. issued October 5, 1993
EX1019	U.S. Patent No. 989,251 to Hall issued April 11, 1911

Exhibit No.	Description
EX1020	Canadian Patent No. 1,320,235 to Kimber granted and published July 13, 1993
EX1021	U.S. Patent No. 3,086,546 to Brown issued April 23, 1963
EX1022	U.S. Patent No. 5,862,538 to Ho issued June 26, 1999
EX1023	U.S. Patent No. 4,980,932 to Stemples issued January 1, 1991
EX1024	U.S. Patent No. 5,708,991 to DeMarco issued January 20, 1998
EX1025	U.S. Patent No. 5,715,860 to Horad issued February 10, 1998
EX1026	U.S. Patent No. 5,134,729 to Shaw issued August 4, 1992
EX1027	U.S. Patent No. 5,855,025 to Williams issued January 5, 1999
EX1028	U.S. Patent No. 6,219,856 to Alles issued April 24, 2001
EX1029	U.S. Patent No. 8,104,105 to Schuster et al. issued January 31, 2012
EX1030	Order Setting Scheduling Conference (Dkt. 39) in <i>Danco, Inc. v. Fluidmaster, Inc., et al.</i> , Case No. 8:23-cv-01156 (C.D. Cal.), entered November 16, 2023
EX1031	Infringement Contentions in <i>Danco, Inc. v. Fluidmaster, Inc., et al.</i> , Case No. 8:23-cv-01156 (C.D. Cal.), served February 24, 2024

I. INTRODUCTION

1. This declaration regarding U.S. Patent No. 9,103,105 (the “’105 patent”) is submitted in connection with the proceeding identified above. I have been retained by counsel for Fluidmaster, Inc. (“Petitioner”) as an independent expert to evaluate claims 1-24 of the ’105 patent (“Challenged Claims”), and to provide opinions in connection with a petition for inter partes review before the Patent Trial and Appeal Board (“the Petition”).

2. I have been requested to compare the Challenged Claims to different prior art references and to consider whether the Challenged Claims are invalid.

3. I am being compensated by Petitioner at my standard hourly consulting rate of \$570 for my time spent on this matter. My compensation is not contingent on the outcome of the IPR or on the substance of my opinions.

4. I have no financial interest in Petitioner or Patent Owner.

II. EDUCATION AND WORK EXPERIENCE

5. In formulating my opinions, I have relied on my knowledge, training, and experience in the relevant field, which I will summarize briefly.

6. I am a Principal Engineer at Engineering Systems Incorporated (ESi), a leading scientific and engineering firm. I specialize in mechanical engineering, materials science and metallurgy, and have extensive experience with materials

evaluation, mechanical design, mechanical testing, stress analysis, failure analysis, fatigue analysis, and fracture mechanics.

7. I graduated with high honors from Princeton University with a degree in Mechanical Engineering and minors in Materials Science, Applied Mathematics and Engineering Physics. I have also received a master's and doctorate in Mechanical Engineering with a minor in Materials Science and Engineering from Stanford University. I have received numerous awards including fellowships from the Department of Defense, the National Science Foundation, and Lucent Technologies. I am a Registered Professional Engineer in both Mechanical Engineering and Metallurgy in the State of California. I am also a registered patent agent. I have taught classes for engineers studying to take the fundamentals of engineering exam and the licensing exam for mechanical engineering.

8. Throughout my career, I have applied my deep understanding of the fundamentals of metallurgy, materials science, engineering physics, computational mathematics, and engineering mechanics to help understand and solve complex problems. Particularly relevant to my declaration here, I have worked on numerous projects across a wide variety of industries related to mechanical systems involving fluid systems and their components as well as mechanical and electrical connectors.

9. For example, related to process piping, I have evaluated joints, their fittings, valves, and support structures. I have also done failure analysis of various

oil and gas distributions systems. This includes evaluating both welded connections as well as joints such as compression couplings. I have also evaluated leak detection systems and integrity management programs for oil and gas distribution systems. I have also consulted on the design and done failure analysis related to water distribution systems. This includes smaller water distribution systems as well as large water mains.

10. As another example, I have experience related to fluid flow in the area of large-scale power generation. I have evaluated the design of hydro generators, turbines, and cooling systems. This includes performing stress analysis of various components under different loading conditions.

11. Also related to fluid flow, I have experience in fire protection systems, including design evaluations and failure analysis. In particular, I have assessed grooved fittings and sprinklers. I have evaluated designs for ease of installation.

12. Relatedly, I have experience in HVAC systems (including the heat exchanger, blower, condenser, etc.) and plumbing systems. I have done design analysis and failure analysis of numerous plumbing components and fixtures, including toilets.

13. I have also performed numerous patent validity and infringement analyses related to piping and connectors. These projects include, but are not limited

to, design evaluation, materials selection, stress analysis, failure analysis, as well as patent validity and infringement analyses.

14. I have done failure analysis of consumer products such as refrigerators, washing machines, dishwashers that involve fluid flow, connectors, hoses and tubing. I have consulted on the design of reinforced hoses for air and water.

15. In the area of medical devices, I have worked on various connectors, valves, pumps and tubing. For example, I consulted on the design of Continuous Positive Airway Pressure (CPAP) machines for sleep apnea that deliver air and medicine, as well as other gaseous drug delivery devices, both of which raise tubing airflow issues. I also consulted on the design of a device that combines an angioplasty balloon with nitrous oxide cooling – a device that also involves connectors, tubing and flow. As another example, I have worked on anesthesia delivery systems that involve fluid flow, tubing and connectors. I have also consulted on the design of valves and pumps for drug delivery.

16. I also have extensive experience on connectors more generally, including mechanical connectors (including male and female connectors) for consumer products, consumer electronics, and medical devices as well as electrical connectors for consumer electronic devices, high speed electrical connectors, photovoltaic connectors, electrical power connectors, and medical devices.

17. I have also performed patent validity and infringement analyses related to piping, fluid flow, and connectors. In connection with a lawsuit against the United States Patent and Trademark Office (“USPTO”), I have also been retained as a technical expert in the area of pipes by the USPTO.

18. A copy of my curriculum vitae is attached as Appendix A to this declaration.

III. SCOPE OF WORK

19. I have reviewed the ’105 patent (EX1001), and the prosecution file history (EX1002), and references cited therein. I have also reviewed other prior art documents as discussed below.

20. I was requested to consider issues regarding validity of the Challenged Claims in this matter and specifically address the following topics in this declaration: the level of skill of persons who would have worked in the field around the time of the alleged invention; and whether the Challenged Claims are invalid as obvious or anticipated.

21. My work described in detail below involved a comparison of the subject matter recited for the Challenged Claims and the subject matter described in publications, patents, and systems that predate the earliest priority date to which the Challenged Claims are entitled, which I understand to be January 27, 2014. I have also been asked to opine on the differences, if any exist, between the subject matter

recited in the Challenged Claims and the prior art. To the extent my conclusion is that differences do exist, I have also been asked to opine on whether the subject matter recited in those claims would have been obvious to a person of ordinary skill in the art for the '105 patent in light of information available at the earliest priority date.

22. My detailed analysis for each ground asserted is included below.

IV. DOCUMENTS RELIED ON

23. In preparing for and writing this declaration and forming the opinions expressed herewith, I reviewed the '105 patent (EX1001), the prosecution file history for the '105 patent (EX1002) and other family members (EX1006, EX1008-EX1012, described in more detail below), the references cited in the prosecution of the '105 patent, additional prior art and other documents referred to herein, and various documents that discuss or refer to the subject matter of these references.

V. SUMMARY OF OPINIONS

24. After analyzing the prior art references and systems discussed herein, the knowledge of a person of skill in the art at the filing date of the '105 patent, and my experience, I conclude that the Challenged Claims are invalid because they are rendered obvious by one or more of the prior art references cited in this declaration.

25. I also conclude that the Challenged Claims are invalid because they are anticipated by Schuster (EX1029).

VI. RELEVANT LEGAL PRINCIPLES AND GUIDELINES

26. I have been informed of certain legal standards by Fluidmaster's attorneys and describe my understanding of those standards in this section. I am relying only on instructions from Fluidmaster's attorneys for these legal standards.

A. LEVEL OF SKILL

27. I understand that patents and prior art are evaluated from the perspective of a hypothetical person of ordinary skill in the art with respect to the subject matter of the '105 patent and prior art.

28. I consider the '105 patent to be within the technological field related to valves and other components of fluid systems, which is supported by the specification of the '105 patent. For example, the '105 Patent is titled "Toilet Fill Valve" and the specification explains that "[a] toilet fill valve in a toilet typically includes a water outlet that provides water for refilling a toilet bowl during a flush cycle," but that such outlets waste water by providing more water than necessary to the toilet bowl during the flush cycle. *See* '105 Patent (EX1001), 1:23-29. The '105 patent purports to solve this problem using a system with a toilet fill valve, a bowl fill restriction that restricts flow of water to the toilet bowl, and a tube that directs water from the bowl fill restriction to the overflow tube of a toilet tank. *See*, e.g., '105 Patent (EX1001), 9:61-12:39.

29. In my opinion, a person of ordinary skill in the art (“POSITA”) with respect to the subject matter of the ’105 patent at the time of the priority date, January 27, 2014, would have had an undergraduate degree in mechanical engineering, or other technical training in product design or equivalent work experience. This person would also possess at least one year of experience in developing and/or evaluating mechanical aspects of fluid systems. I consider myself a person of ordinary skill in the art under this definition.

30. My opinion on the background of a POSITA is based on consideration of the following factors: (1) type of problems encountered in the art; (2) prior art solutions to those problems; (3) rapidity with which inventions are made; (4) sophistication of the technology; and (5) educational level of active workers in the field.

31. I have considered the issues and arrived at the conclusions discussed in my declaration from the perspective of this person of ordinary skill. I am, therefore, discussing what I believe a person of ordinary skill would have understood to be disclosed or suggested by a prior art reference during the relevant time period when analyzing that reference’s disclosure.

B. CLAIM CONSTRUCTION

32. I have applied my understanding of the legal standards concerning claim construction, as discussed below, when analyzing the Challenged Claims.

33. I have been instructed by counsel that claim construction is a matter of law for the arbiter of law to decide. I understand that in an *inter partes* review, claims are construed using the same claim construction standard that would be used to construe the claims in a civil action.

34. I understand that claim terms should be assigned their ordinary and customary meaning within the context of the asserted patent. In other words, a claim term is supposed to be given the meaning that the claim term would have to a person of ordinary skill in the art at the time of the invention in light of the teachings of the patent. I also understand that in some circumstances, a claim term may not have an ordinary and customary meaning to a person of ordinary skill in the art.

35. I understand that you look to sources such as the words of the claim, the asserted patent's specification, the prosecution history of the asserted patent (all of which are considered intrinsic evidence), as well as extrinsic evidence concerning the meaning of technical terms, the state of the art at the time of the invention, and relevant scientific principles, to determine how a person of ordinary skill in the art would understand a claim term. I understand that the intrinsic evidence is the primary evidence considered, but that it is also useful to look at extrinsic evidence when the intrinsic evidence is not sufficient so long as the extrinsic evidence is consistent with, and not contradictory to, the intrinsic evidence.

36. I understand that the patentee can act as her own lexicographer to provide special meaning to claim terms or to intentionally disclaim any claim scope.

37. I understand that claims define the scope of the patent and the subject matter of the invention. Because of this, I understand that claim construction begins and remains focused on the claim language. I also understand that the context in which claim terms are used is very instructive in construing the claim. For example, the same term is given a consistent meaning throughout the patent, and the use of one term in a claim can provide meaning of the same term in other claims. Differences between the terms used in a claim are also useful. I further understand that when a claim lists elements separately, those elements are typically construed as distinct components of the invention.

38. I understand that a person of ordinary skill in the art also reads claim terms in the context of the entire patent, including the specification, so claims must be construed in light of the entire specification. At the end, the interpretation of a claim term must be confirmed in view of a full understanding of what the inventors actually invented.

39. I understand that the purpose of the specification is to describe and enable the invention so a claim term cannot have broader scope than the invention that is described in the patent. I also understand that the full scope of the claims must be supported by the specification.

40. I understand that the prosecution history is also part of the intrinsic evidence. The prosecution history can provide evidence of how the Patent Office and inventors understood the terms of the patent in light of the prior art. I also understand that a patentee could make arguments or amendments during prosecution that narrow the scope of a claim term or scope of the invention.

41. I understand that extrinsic evidence including testimony from experts and inventors, dictionaries, and treatises can be considered to determine the meaning of a claim term. I understand that extrinsic evidence should not be considered when it is not in the context of the intrinsic evidence. I also understand that extrinsic evidence should not be considered unless a claim term is ambiguous after consideration of intrinsic evidence. I further understand that extrinsic evidence is given less weight than intrinsic evidence.

42. I understand that a preamble term or phrase is not limiting when a complete invention is described in the claim body and the preamble is only used to state the purpose or use of the invention. I understand that the preamble can be limiting if it recites structure or steps that are essential or gives meaning to the claim. To determine whether the preamble is limiting, you should review the entire patent to determine what the inventors intended to have the claims encompass.

43. I understand that the preamble can be limiting if the claim is dependent on a preamble phrase and indicates it through use of an antecedent basis to define

the invention, if the reference is necessary to understand the terms of the claim, and if the preamble provides additional structure or steps that is important to the claim.

44. I understand that claims can be written in means-plus-function form where the claim receives a feature of the invention by what it does rather than what it is. I understand that a claim element is a means-plus-function element when it is defined as a means or step for performing a function without description of the corresponding structure. I also understand that “mechanism,” “structure” or other generic words can also signal that a limitation is written in means-plus-function form. I understand that means-plus-function claims only cover the corresponding structure, material, or acts that are described in the specification, as well as any equivalents.

45. I also understand that generally a claim should not be limited to a preferred embodiment described in the specification, but that, in certain cases, the scope of the right to exclude may be limited by a narrow disclosure.

1. “Integrally Molded”

46. The term “integrally molded” is not used in the specification of the ’105 patent. *See* ’105 patent (EX1001). It is my opinion, based on my understanding of the law of claim construction that the term “integral” is defined within the specification of the ’105 patent to mean a “single structure” that includes forming together as a single piece construction, or snapped or clamped into place, or attached

in some other manner. *See* '105 patent (EX1001), 2:17-26. In particular, the inventors state that

In this respect, the term “integral” refers to the fact that the bowl fill valve 109 and the toilet fill valve 100 comprise a single structure. In this respect, the bowl fill valve 109 may be included within the body of the toilet fill valve 100 as a portion of the toilet fill valve 100 in a single piece construction. Specifically, the bowl fill valve 109 may be molded as a portion of the toilet fill valve 100 or it may be snapped or clamped into place, or it may be attached to the toilet fill valve 100 in some other manner, etc.). '105 patent (EX1001), 2:17-26.

Similarly, the specification again explains that:

In addition, the toilet fill valve 200 includes a bowl fill valve 203 that is integral with the toilet fill valve 200 as will be described. As stated above, the term “integral” refers to the fact that the bowl fill valve 200 and the toilet fill valve 100 comprise a single structure. In this embodiment, the bowl fill valve 200 is a separate component that is attached the body of the toilet fill valve 100, thereby forming the integral, single structure. '105 patent (EX1001), 4:63-65.

47. It is my opinion that the term “integral” should be construed as a single structure or multiple structures connected to one another to form a single structure, which is also consistent with my understanding of the term and how a person of ordinary skill in the art would understand the term. Furthermore, it is my understanding that the term “integrally molded” should be construed consistent with the definition of integral. For the purpose of the Petition, it is my opinion that the expression “integrally molded” should be construed to mean molded together as a single structure or molded separately and subsequently attached to one another to

form a single structure. To the extent that PO proposes a different construction, I reserve the right to respond and provide further analysis of the claims.

2. “Bowl Fill Restriction”

48. The expression “bowl fill restriction” is not used in the specification of the ’105 patent, other than in the Abstract and claims. *See* ’105 patent (EX1001). While a “bowl fill *valve*” is disclosed, a “bowl fill *restriction*” is not disclosed in the specification, nor do the terms “restriction” or “constricted” appear in the originally filed specification. *See* ’105 Patent File History (EX1002) at 124-143.

49. The first time the term “restriction” appeared was January 27, 2014, the filing date of the application that issued as US 9,139,993, (the “’993 patent”), the ’105 patent parent. *See* ’993 patent File History (EX1008, 103–147). More specifically, the Patent Owner (“PO”) amended the Abstract and claims to eliminate any references to the bowl fill being “adjustable” and to a “bowl fill valve” in the preceding applications (*see, e.g.*, E1012, at 55 and 52–54), and replaced that language with a “bowl fill restriction” (*see, e.g.*, E1008, at 138 and 133–137). Ten days later, on February 6, 2014, PO filed preliminary remarks in which they explicitly stated that the independent claims reciting a “bowl fill restriction” were broader than “a bowl fill valve”—the only device disclosed that can control or adjust the flow through the bowl refill tube. EX1008-084 – EX1008-085.

50. In plumbing applications, it is typically understood that flow restrictors are fixed devices and valves are adjustable devices. *See, e.g.*, Appendix B, ASSE International Plumbing Dictionary 6th Edition, p. 9 (defining “flow restrictor (fixed)” as “a component or accessory which incorporates a flow restricting orifice of ***fixed*** geometrical construction...” (emphasis added); p. 10 (defining “valve” as “a device by which the flow may be started, stopped, or regulated by a moveable part which opens, or obstructs, the passage”). However, by its amendments to the Abstract and the claims, and the statements in the Preliminary Remarks, in my opinion a person of ordinary skill in the art would understand that PO was intending to broaden the disclosure and was using the term “bowl fill restriction” in the Abstract and the claims to encompass not only adjustable bowl fill valves, but also non-adjustable (fixed) flow restrictors. PO also served infringement contentions asserting that the bowl flow restriction of the claims cover (i.e., read on) both adjustable valves and fixed flow restrictors. *See, e.g.*, EX1031, Ex. A at 4, Ex. C at 3. In view of the foregoing and my understanding of the law of claim construction, it is my opinion that for purposes of this petition, the term “bowl flow restriction” should be construed to include an adjustable or fixed device for restricting the flow of water.

51. To the extent that PO proposes a different construction, I reserve the right to respond and provide further analysis of the claims.

52. I note that claim 6 of the '105 patent recites “the bowl fill valve,” which lacks antecedent basis in claim 6 or claim 1 from which it depends. However, for purposes of the Petition, I assume “the bowl fill valve” in claim 6 refers to the “bowl fill restriction” of claim 1.

C. PRIOR ART AND PRIORITY DATE FOR THE '105 PATENT

53. I understand that a patent, publication, or product must qualify as prior art before it can be used to invalidate claims in a patent.

54. I understand that the America Invents Act (“AIA”), which changed the United States from a “first-to-invent” to “first-to-file” system, changed the law on what qualifies as prior art. I understand that post-AIA law to determine what qualifies as prior art should be applied here in view of the January 27, 2014 priority date of the '105 patent as discussed below in Paragraphs 354-369. I understand that if this priority date is not adopted, then pre-AIA law will be used to determine what qualifies as prior art. If there turns out to be a dispute about the priority date, I reserve the right to respond further.

55. I understand that a prior art patent or published patent application qualifies as prior art if the effective filing date of that reference is prior to the effective filing date of the asserted patent.

56. I understand that a prior art product qualifies as prior art if the product was in public use, on sale, or otherwise available to the public before the effective filing date of the asserted patent.

57. I understand that a reference qualifies as a printed publication if it was publicly accessible prior to the effective filing date of the asserted patent. I also understand that public accessibility is determined on a case-by-case basis, but that a publication is generally publicly accessible if it was distributed or otherwise made available, where interested persons ordinarily skilled in the art could locate it by exercising reasonable diligence.

58. Unless explicitly noted, I have applied the January 27, 2014 priority date in my analysis of the prior art. So, in my analysis of the prior art, I include patents, printed publications, and products in public use, on sale, or otherwise available to the public prior to January 27, 2014. To the extent it is determined that the '105 patent is entitled to an earlier priority date than January 27, 2014, I reserve the right to supplement my anticipation and obviousness analysis in light of the earlier priority date. However, as noted below, the Guoxin, Brown, Ho, and Quick Connection Art references qualify as prior art even in view of the earliest potential priority date on the face of the '105 patent—on its face, the '105 patent claims priority through a series of continuations and one continuation-in-part to U.S.

Application No. 10/798,606, filed on March 11, 2004, now U.S. Patent No. 6,823,889.

59. I understand that patents, printed publications, products, and other materials that qualify as prior art can invalidate an asserted claim as anticipated or obvious.

60. I understand that invalidity must be shown by clear and convincing evidence.

D. ANTICIPATION

61. I understand that under 35 U.S.C. § 102, if a prior art reference discloses all limitations of an asserted claim, then the claim is invalid. I understand that a patent claim is anticipated only if each and every limitation of the claim is found in a single prior art reference, either explicitly or inherently, arranged as set forth in the claim.

E. OBVIOUSNESS

62. I understand that under 35 U.S.C. § 103, if a prior art reference discloses fewer than all limitations of an asserted claim, the claim is still invalid if the differences between the subject matter of the claim and the prior art reference would have been obvious at the time of the invention to a person of ordinary skill in the art. I understand that obviousness can be based on a single prior art reference or a

combination of references that disclose all of the limitations of an asserted claim, whether expressly or inherently.

63. I understand that the prior art reference and subject matter of the claim should be viewed from the perspective of one of ordinary skill in the art. I also understand that hindsight bias and insight cannot be used when determining whether a claim is obvious.

64. I understand that the following standards, which were provided by the Supreme Court of the United States in *KSR v. Teleflex*, may be applied during an obviousness analysis: (1) combining the prior art elements according to known methods to yield predictable results; (2) simple substitution of one known element for another to obtain a predictable result; (3) using a known technique to improve similar devices or methods in a similar way; (4) applying a known technique to a known device or method that is ready for improvement where the application produces predictable results; (5) “obvious to try” i.e., choosing from a limited, finite, number of predictable solutions with a reasonable expectation of success; (6) variations of known work in one field of endeavor applied in the same field or a different field based on market forces such as design incentives, if the variations would have been predictable to a person of ordinary skill; and (7) a teaching, suggestion, or motivation to combine the prior art reference disclosure to arrive at

the claimed invention, where the teaching, suggestion, or motivation could be supplied by the knowledge of a person of ordinary skill in the art.

65. I understand that relevant factual considerations for an obviousness analysis include: (1) the scope and content of the prior art; (2) differences between the prior art and subject matter of the invention; and (3) the level of a person of ordinary skill in the art.

66. I understand that, in certain circumstances, secondary considerations of non-obvious can rebut a prima facie showing of obviousness including: (1) a long-felt need unmet in the prior art but met by the invention claimed in the asserted patent; (2) the commercial success or lack thereof of products or processes covered by the asserted patent; (3) unexpected results achieved by the invention claimed in the asserted patent; (4) licenses of the asserted patent by third parties; and (5) deliberate copying of the invention claimed in the asserted patent. I also understand that secondary indicia are only considered if there is a relationship between the indicia and the invention. I also understand that independent invention of the subject matter by others at the time of the invention supports a finding of obviousness.

67. I understand that it can be important to describe a reason that would motivate a person of ordinary skill in the art to combine elements of the prior art in the way as claimed in the asserted patent, although this is not required by 35 U.S.C. § 103.

68. I understand that, ultimately, obviousness is a legal conclusion supported by factual considerations, which is based on a showing that all of the limitations of an asserted claim are present in the prior art and that the combination of the elements disclosed in the prior art is a predictable variation prompted by a known problem, design incentives, other market factors, or the knowledge of a person of ordinary skill, who would have implemented the combination with a reasonable expectation of success.

69. I understand that an obviousness analysis can be based on a combination of multiple prior art references. I also understand that the teaching, suggestion, motivation, or other reason to combine the references may be supplied by the references themselves or the common sense of a person of ordinary skill in the art. I also understand that market forces often drive innovation compared to scientific literature, and that a motivation to combine may be supplied by these market forces.

70. I understand that a person of ordinary skill in the art would recognize that a technique used to improve one device could be used to improve similar devices in the same way unless actual application of that technique is beyond the person's skill.

71. I understand that an obviousness analysis should be guided by practicality and common sense because sometimes familiar items have obvious uses

beyond their primary purpose. I also understand that a person of ordinary skill is often able to combine the teachings of publications similar to pieces of a puzzle, where a person of ordinary skill in the art can also employ inferences and creative steps.

72. I understand that obviousness can be shown where it would have been obvious for a person of ordinary skill to try the combination, such as when market forces pressure a resolution to a problem for which there are a finite number of known, predictable solutions, or when a person of ordinary skill has reason to pursue known options because the result is the product of application of ordinary skill and common sense.

73. I understand that the combination of familiar elements according to known methods leading to predictable results that discloses all limitations of a claim can render the claim obvious. I understand that market forces can also drive variations of a limitation, whether in the same field of endeavor or a different one. If a person of ordinary skill in the art can implement the predictable variation, the limitation is rendered obvious.

74. I understand that the relevant question when combining prior art references is whether the techniques taught by the prior art are interoperable with each other such that a person of ordinary skill in the art would view them as a design choice or whether they could apply the techniques into a new combined system.

75. I understand that an obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art and is not limited to a patentee. Therefore, any need or problem known in the field of endeavor at the time of the invention that is addressed by the asserted patent can provide a reason for combining the elements found in the prior art.

76. I understand that a single prior art reference can render a claim obvious if the missing elements of the reference are supplied by the knowledge of a person of ordinary skill in the art.

77. I understand that the inherent teachings of the prior art are also applicable to the determination of obviousness.

78. I understand that prior art teachings can be combined when a person of ordinary skill in the art, using their understanding and knowledge would have combined the elements recited in the claims motivated by the general problem facing the inventor of the asserted patent. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor at the time of the invention, can provide a reason for combining the elements of multiple prior art references in the claimed manner.

79. I understand that a comparison of the disclosure of the prior art versus properly construed limitations of an asserted claim is necessary to performing an obviousness analysis.

80. I understand that a means-plus-function limitation can be rendered obvious when a prior art reference, in combination of the knowledge of one of skill in the art, or a combination of references address both the function and corresponding structure of the limitation-at-issue, or an equivalent of the structure. The function and corresponding structure of the means-plus-function limitation must have been obvious at the time the invention was made to a person having ordinary skill in the relevant art in light of the teachings of the prior art.

VII. BACKGROUND AND OVERVIEW OF THE '105 PATENT

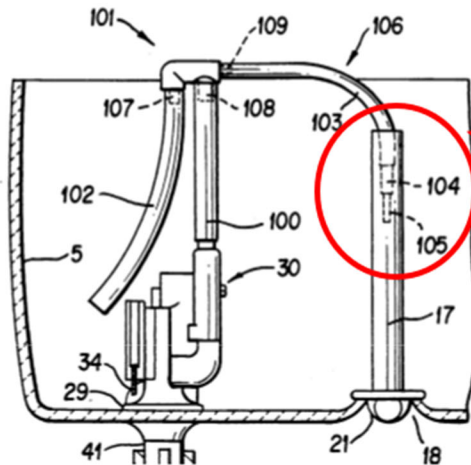
A. TECHNOLOGICAL BACKGROUND

81. The '105 patent is directed to a purported improvement to a toilet fill valve for a flush toilet. *See* '105 patent (EX1001), Abstract. Toilet fill valves are not new. *See*, e.g., Brown (EX1021), which was filed March 6, 1959. Rather, toilet fill valves with various mechanisms to control the flow of water to the toilet bowl during a flush cycle were well known in the art. After a toilet is flushed, the toilet fill valve is responsible for refilling the water stored in the toilet's tank and in the toilet's bowl. The toilet fill valve is connected to the water supply line for the toilet and allows water to flow (1) into the tank and (2) into the bowl through a connection to the toilet's overflow tube. The toilet fill valve controls the amount of water used to refill the tank and the bowl and closes the valve once the flush cycle is complete.

82. Water saving mechanisms were also well known. For example, Brown discloses two water saving mechanisms. The first mechanism is a valve attached directly to the bowl refill outlet on the toilet fill valve that allows the amount of water flowing into the toilet bowl to “be reduced to the necessary minimum.” Brown (EX1021), 3:65-68. The second mechanism is a U-shaped tube extending from the bowl refill outlet of the toilet fill valve that has a smaller (restricted) diameter than conventional refill tubes but lacks the “feature of adjustability.” *Id.*, 4:20-44. Brown therefore informs a POSITA that both a bowl fill valve and a reduced diameter bowl fill tube (bowl fill restrictor) can reduce the flow of water to the overflow tube, but that the reduced diameter bowl fill tube lacks adjustability.

83. Once a bowl fill restrictor is inserted and in place, it is no longer adjustable. I list several examples of flow restrictors from the prior art below.

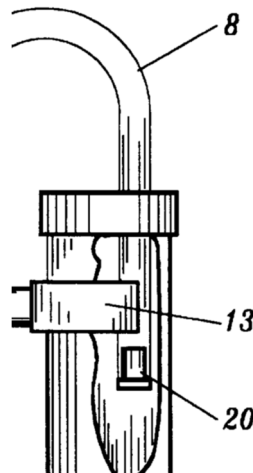
84. As shown in annotated Figure 3 below, U.S. Patent No. 5,134,729 to Shaw (“Shaw,” EX1026) discloses flow restrictors (104, 105) having varied decreased diameters. *See, e.g.*, Shaw (EX1026), 8:8-20; Fig. 3 annotated (below).



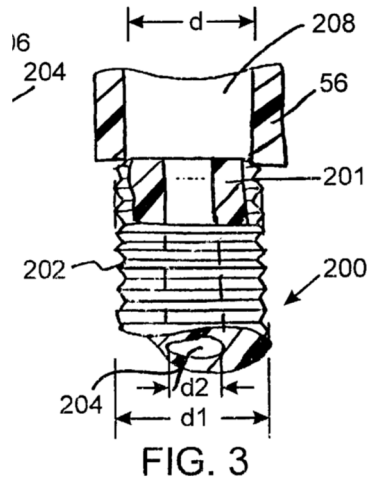
The free end of bowl fill assembly 106 is inserted in overflow tube 17. Bowl fill assembly 106 comprises bowl fill tube 103 and optional flow control inserts 104 and 105.

Tubes 100 and 102 are plastic tubes having an interior diameter of approximately one half inch. Bowl fill tube 103 has an interior diameter of three-eighths of an inch and flow control inserts 104 and 105 have interior diameters of one-quarter inch and three-sixteenths inches, respectively. Flow control inserts 104 and 105 are retained in bowl fill tube assembly 106, when used, by frictional contact between their outer surface and the inner surface of the tube in which they are inserted.

85. As shown below in Figure 1 of U.S. Patent No. 5,855,025 to Williams (“Williams,” EX1027) below, Williams discloses a bowl refill restrictor (20) to divert a lower amount of water to the bowl than to the tank. *See Williams (EX1027), 3:8-17, Fig. 1.*



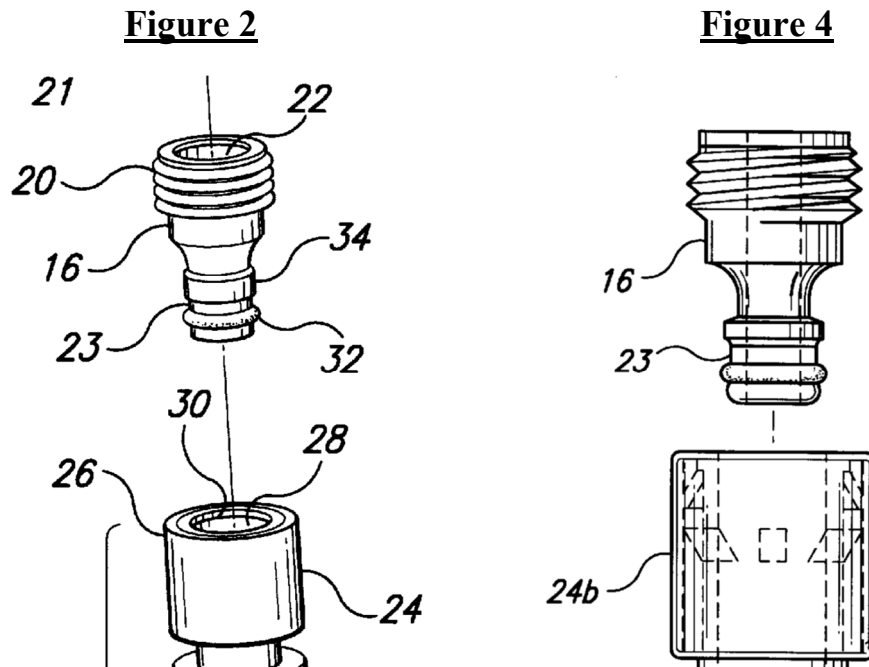
86. As shown below in Figure 3 of U.S. Patent No. 6,219,856 to Alles (EX1028), a bowl refill restrictor (200) reduces the flow of water into the bowl. *See Alles (EX1028), 3:6-36, Fig. 3.*



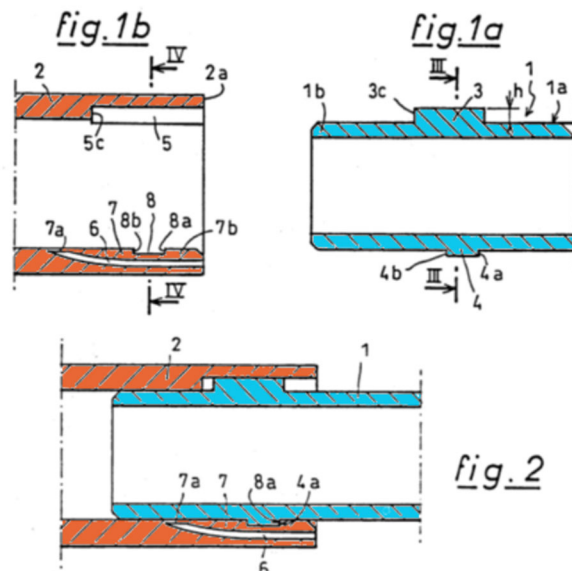
87. In addition to restrictors, different ways of connecting components of a fluid system were well known - including quick connect couplings used in systems for water flow. While the '105 patent is directed to a toilet component, the underlying technology generally consists of techniques, mechanisms, and apparatuses (e.g., pipes, valves, connectors, fixtures, etc.) to deliver and transport fluid in a controlled manner. Thus, a POSITA would look more generally to fluid flow components, including the art similar to that described below, in the design of toilet components. I will generally refer to this art related to quick connect couplings as the Quick Connection Art.

88. As an example, during prosecution of the grand-child application of the '105 patent, now U.S. 10,934,698 (the "'698 patent"), the Examiner cited U.S. Patent No. 5,926,868 to Bjerke ("Bjerke," EX1017) as disclosing a conventional quick-connect coupling for a water flow system. *See* '698 File History (EX1006) at

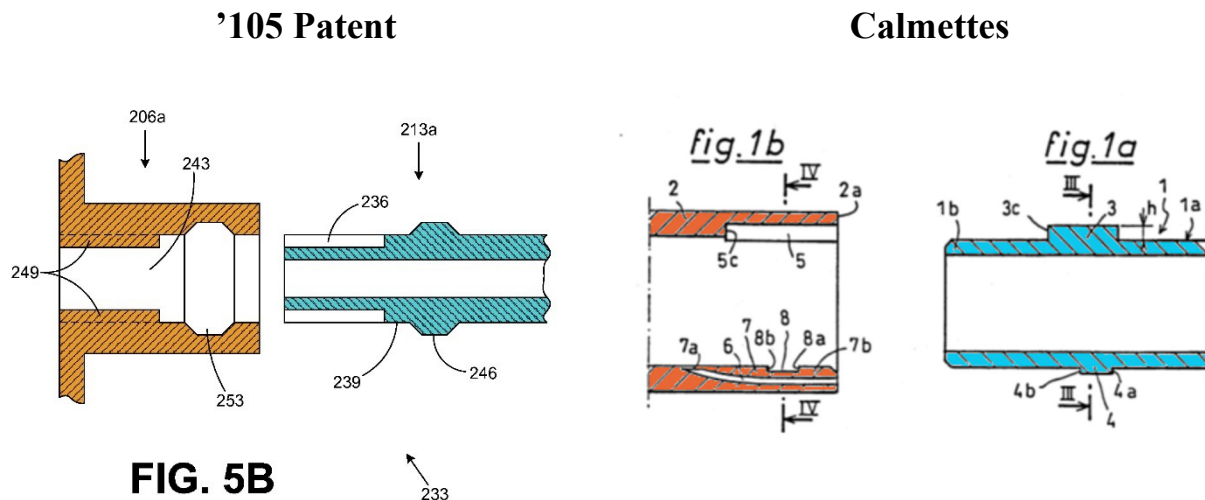
64-65. Bjerke's quick connector, adapted for use in a bathtub shower system, is shown in Figs. 2 and 4 below.



89. Similarly, U.S. Patent No. 5,249,830 to Calmettes ("Calmettes," EX1018) discloses a coupling device to lock snap-fit and lock two coaxial fluid flow tubes. *See* annotated Figures 1a (orange tube), 1b (blue tube), and 2 (tubes coupled together) of Calmettes reproduced below.

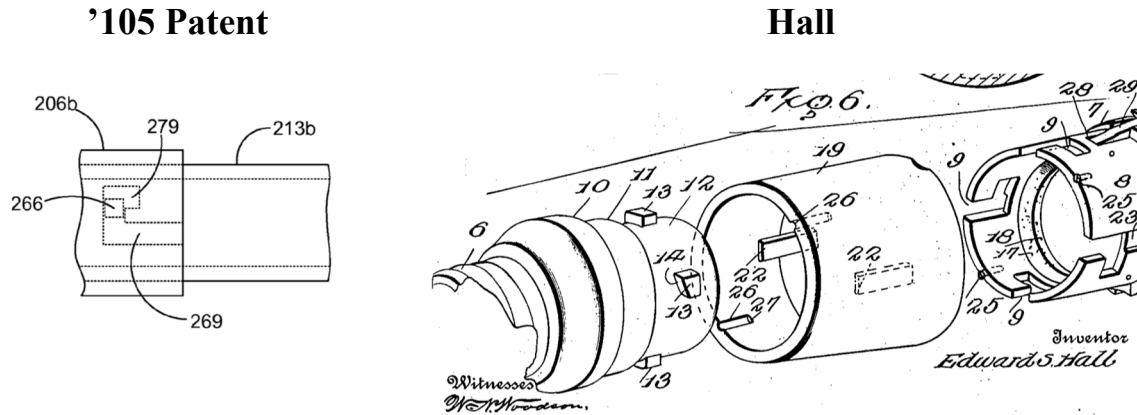


90. Calmettes' snap fit connection is the same type of connection illustrated in Figures 5A and 5B of the '105 patent. *See, e.g., '105 patent (EX1001), Figure 5B (reproduced below), compared to Calmettes (EX1018), Figs 1a and 1b.*

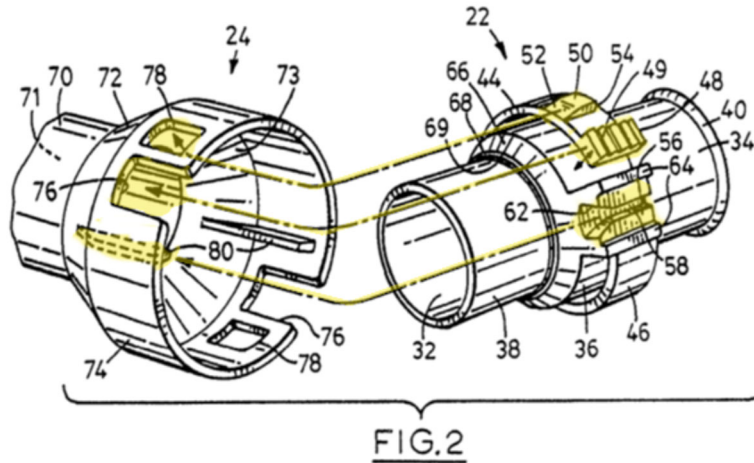


91. U.S. Patent No. 989,251 to Hall ("Hall," EX1019) discloses a fluid flow coupler in which axial protrusions 13 (lugs) on the male portion mate with grooves

9 (bayonet slots) formed in the female portion, and can be rotated to lock in place. See Hall (EX1019), Figure 6 (reproduced below). Notably, Hall's coupling is the same type as that shown in Figures 6A-6C of the '105 patent. See, e.g., '105 patent (EX1018), Figure 5B (reproduced below), compared to Hall, Fig. 6 (below).



92. Canadian Patent No. 1,320,235 to Kimber ("Kimber," EX1020) discloses a pipe coupling that comprises a male fitting and a tubular female fitting. As shown in annotated Figure 2 below, Kimber illustrates the coupling arrangement between male fitting 22 and tubular female fitting 24 where tabs can snap into apertures and axial grooves mate with ribs to prevent axial movement.



B. PURPORTED INVENTION OF THE '105 PATENT

93. The purported invention recited by the Challenged Claims concerns a toilet fill valve that dispenses water in two portions. *See* '105 patent (EX1001), Abstract. A first portion of water exits the fill valve via a tank water outlet situated at its lower portion to refill the tank. *Id.* A second portion of water exits through an extended part of the toilet fill valve, which is attached to an adjustable bowl fill valve to adjust the flow of water to refill the bowl. *Id.* Because the adjustable valve could create a pressure head in a hose connecting it to the toilet fill valve, the '105 patent eliminates the hose and directly connects the bowl fill valve to the toilet valve. PO argued this direct connection and preventing a pressure head as a feature distinguishing the claims from the cited art. *See* '105 patent (EX1001), 3:64-4:3; Prosecution History for the '671 patent (EX1009), 72-73.

C. SUMMARY OF THE PROSECUTION HISTORY OF THE '105 PATENT

94. U.S. Application No. 14/457,697 (the “'697 application”) was filed on August 12, 2014, and issued on August 11, 2015, as the '105 patent. *See* '105 patent (EX1001), p. 1. The '697 application claims priority as a continuation of application No. 14/164,424, filed on January 27, 2014, which claims priority through a series of continuations and one continuation-in-part to U.S. Application No. 10/798,606, filed on March 11, 2004, now U.S. Patent No. 6,823,889. *Id.*

95. The '697 application claims were rejected for, *inter alia*, obviousness based on U.S. Patent Nos. 5,708,991 (“DeMarco”) and 6,047,725 (“Gish”). *See* Prosecution History for '105 patent (EX1002) at 62–70. The Examiner stated that while DeMarco taught nearly all aspects of the claims, it was silent on its extended portion being integrally molded with the toilet fill valve body. *Id.*, 65–66. However, an extended portion being integrally molded with the toilet fill valve body was disclosed by Gish and it would have been obvious to use that in the DeMarco device as a cost-effective method of manufacturing. *Id.*, 66.

96. PO responded by amending various claims, introducing new claims 21–24, and providing additional remarks. *Id.*, 32–53. PO traversed the Examiner's obviousness rejections by amending the claims to recite “a protrusion [on the bowl fill valve] configured to insert into a recess in a toilet fill valve,” a feature PO alleged was not disclosed in DeMarco. PO stated that DeMarco lacked such a protrusion or

recess and did not “lock” in place. *Id.*, 45–47. PO further alleged that Gish did not provide this missing information. *Id.*, 47.

97. PO later filed a terminal disclaimer, which was approved, and the Examiner allowed all claims. *Id.*, 19–23, 7–11. No reasons for allowance were given.

D. SUMMARY OF THE PROSECUTION HISTORIES OF THE RELATED PATENTS

98. The ’105 patent claims priority to a number of issued patents, and PO has obtained later patents claiming priority to the same family of applications. For the purposes of my analysis here, I refer to all patents issued from applications in the same family tree as “related patents.” The prosecution histories of the related patents are provided at EX1006, EX1008-EX1012.

VIII. VALIDITY ANALYSIS OF THE CHALLENGED CLAIMS

99. In this section, I provide an overview of the most relevant prior art references and then provide a detailed explanation of how the references invalidate the Challenged Claims.

100. I have also indicated where the knowledge of a person of ordinary skill in the art at the time the alleged invention was made would have made various limitations obvious. The citations below are illustrative, not exhaustive, of the disclosure contained within that reference or demonstrated by that product. For any particular citation or disclosure, I reserve the right to introduce additional disclosure or images to the extent allowed. I further reserve the right to introduce other text,

figures, or disclosure from the same or other documents concerning that reference to provide additional context for the citation. Where I provide a citation to a particular figure, the citation should be understood to encompass the disclosure relating to that figure and vice versa. I also reserve the right to rely upon other documentation or information produced in this proceeding, such as deposition testimony or evidence relied on by Patent Owner's experts, to explain or provide additional context to the cited portion of each reference discussed herein.

A. BRIEF OVERVIEW OF THE PRIOR ART REFERENCES

1. Registered Utility Model Publication Number CN2447417Y to Guoxin ("Guoxin")

101. Registered Utility Model Publication Number CN2447417Y to Guoxin was published on September 12, 2001 (EX1015, Certified Translation at EX1016, "Guoxin"). I understand that Guoxin is prior art under 35 U.S.C. § 102 (both pre and post AIA) because it is a printed publication filed before the earliest claimed priority date for the Challenged Claims.

2. U.S. Patent No. 3,086,546 to Brown ("Brown")

102. U.S. Patent No. 3,086,546 to Brown issued on April 23, 1963 (EX1021, "Brown"). I understand that Brown is prior art under 35 U.S.C. § 102 (both pre and post AIA) because it is a printed publication filed before the earliest claimed priority date for the Challenged Claims.

3. U.S. Patent No. 8,104,105 to Schuster et al. (“Schuster”)

103. U.S. Patent No. 8,104,105 to Schuster et al. issued on January 31, 2012 (EX1029, “Schuster”). I understand that Schuster is prior art under 35 U.S.C. § 102 (post AIA) because it is a printed publication filed before the earliest claimed priority date for the Challenged Claims.

4. U.S. Patent No. 5,862,538 to Ho (“Ho”)

104. U.S. Patent No. 5,862,538 to Ho issued on June 26, 1999 (EX1022, “Ho”). I understand that Ho is prior art under 35 U.S.C. § 102 (both pre and post AIA) because it is a printed publication filed before the earliest claimed priority date for the Challenged Claims.

5. U.S. Patent No. 5,926,868 to Bjerke (“Bjerke”)

105. U.S. Patent No. 5,926,868 to Bjerke issued on July 27, 1999 (EX1017, “Bjerke”). I understand that Bjerke is prior art under 35 U.S.C. § 102 (both pre and post AIA) because it is a printed publication filed before the earliest claimed priority date for the Challenged Claims.

6. U.S. Patent No. 5,249,830 to Calmettes, et al. (“Calmettes”)

106. U.S. Patent No. 5,249,830 to Calmettes, et al. issued on October 5, 1993 (EX1018, “Calmettes”). I understand that Calmettes is prior art under 35 U.S.C. § 102 (both pre and post AIA) because it is a printed publication filed before the earliest claimed priority date for the Challenged Claims.

7. U.S. Patent No. 989,251 to Hall (“Hall”)

107. U.S. Patent No. 989,251 to Hall issued on April 11, 1911 (EX1019, “Hall”). I understand that Hall is prior art under 35 U.S.C. § 102 (both pre and post AIA) because it is a printed publication filed before the earliest claimed priority date for the Challenged Claims.

8. Canadian Patent No. 1,320,235 to Kimber (“Kimber”).

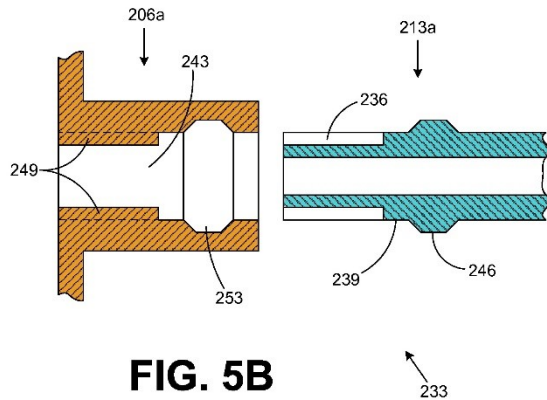
108. Canadian Patent No. 1,320,235 to Kimber was granted on and published on July 13, 1993 (EX1020, “Kimber”). I understand that Kimber is prior art under 35 U.S.C. § 102 (both pre and post AIA) because it is a printed publication filed before the earliest claimed priority date for the Challenged Claims.

B. Claims 1-3, 6, 8-15, and 20-24 are Obvious Under 35 U.S.C. §103 Over Guoxin in View of Ho

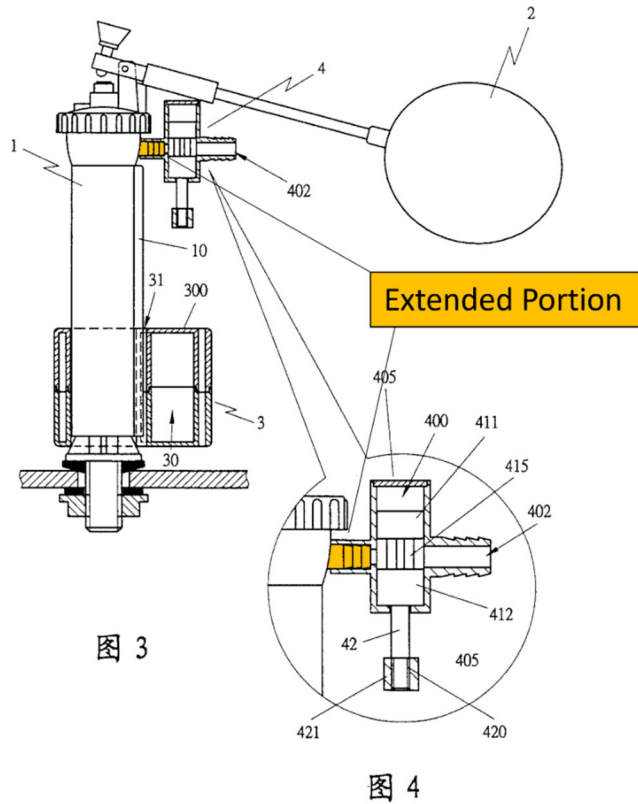
109. Guoxin (EX1015-EX1016) was not considered during prosecution of the ’105 patent and is more material than the prior art considered.

110. The only discernible difference between claims 1-3, 6, 8-15, and 20-24 of the ’105 patent and Guoxin is that Guoxin discloses the reverse coupling arrangement between the bowl fill restriction and the toilet fill valve (i.e., the bowl fill restriction has a recess, and the extended portion of the toilet fill valve has a protrusion). *See* ’105 patent (EX1001), annotated Fig. 5B; Guoxin (EX1016), annotated Figure 4.

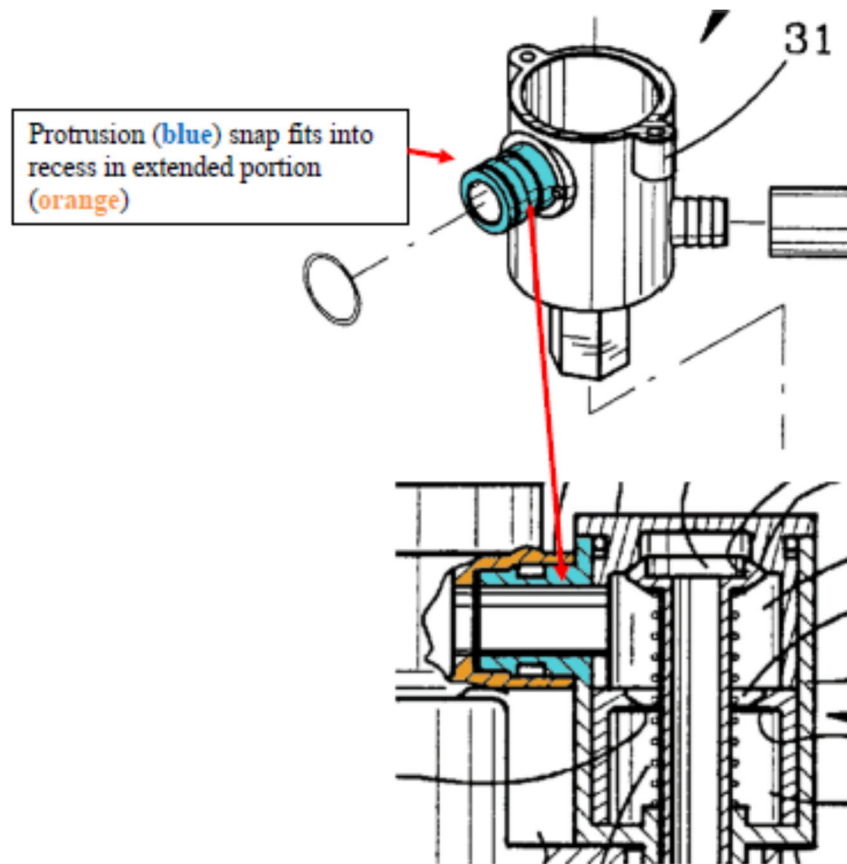
'105 Patent



Guoxin



111. Ho discloses an integrally molded extended portion on a toilet fill valve with a recess into which a bowl fill restriction device with a protrusion is inserted and locked into place. *See* Ho (EX1022), annotated Figs. 3 and 5 below.



112. Ho was not considered during prosecution of the '105 patent and is more material than the art considered.

113. Both Guoxin and Ho are directed to toilet valve systems. *See, e.g.*, Guoxin (EX1016), p. 2 (title “Toilet Water Tank Water Supply Switching Device”); Ho (EX1022), p. 1 (title “Toilet Flushing Device”). The systems of both Guoxin and Ho utilize and describe bowl fill restrictions (e.g., “switching mechanism 4” in Guoxin and “diverter valve means 30” in Ho) that attach directly to the toilet fill valve to accurately control the amount of water that flows from the toilet fill valve into the toilet bowl. *See, e.g.*, Guoxin (EX1016), 5:1-2 (“By adopting the said solution: This achieves more accurate control of the switching valve for the water

supply...”), Figs. 1-4; Ho (EX1022), 1:6-9 (“This invention relates to a toilet flushing device, more particularly to a toilet flushing which has a diverter valve unit for directing water from the water supplying pipe to the rim flushing conduit of the toilet bowl.”), Figs. 1-5.

114. One of ordinary skill in the art would understand that male and female fluid flow connectors are generally interchangeable and the decision to make one component a male connector and the other a female connector is a matter of design preference. For example, Bjerke (EX1017) shows that male and female connectors can be reversed in relation to each other and are thus interchangeable. *See* Bjerke (EX1017), 7:15-24, Figs. 5-6 (reproduced below).

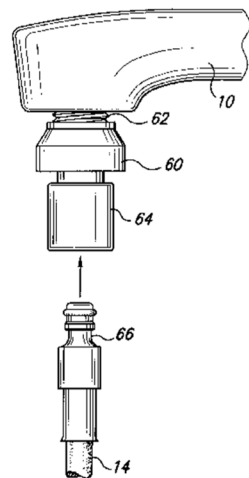


Fig. 5

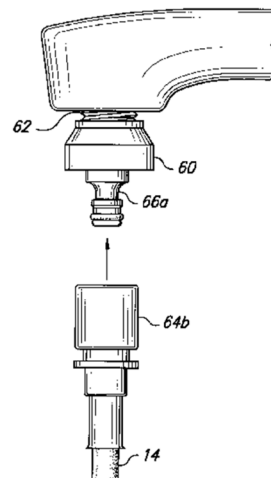


Fig. 6

115. As another example of the interchangeability of male and female connectors, and specifically connectors for toilet fill valves, the obviousness of such a substitution is also supported by the prosecution of the grandchild '698 patent,

where PO presented claim 3, which recited the precise arrangement disclosed by Guoxin (e.g., male protrusion as the bowl fill outlet port and female receptacle at the bowl fill inlet port) and referred to paragraphs [0033] and [0042] of the specification as support. Prosecution History for the '698 Patent (EX1006), 80-81. In particular, Paragraph [0033] states:

...the bowl fill outlet port 206 may comprise a female receptacle and, correspondingly, the bowl fill valve inlet port 213 may comprise a male end compatible with a female receptacle. Alternatively, the bowl fill valve inlet port 213 may comprise a female receptacle and the bowl fill outlet port 206 may comprise a male end compatible with such female receptable.

Id.

116. Paragraph [0042] also states with respect to the connectors shown in Figs. 5A and 5B that “**it is possible that this arrangement may be reversed....**”

Id. (emphasis in original). It is clear from the '105 patent specification and the intrinsic evidence that PO placed no criticality on which portion of the coupling was the male portion and which portion was the female portion. Placing a protrusion on the bowl fill restriction or on the toilet fill valve bowl fill outlet port therefore would have been an obvious design choice to a POSITA.

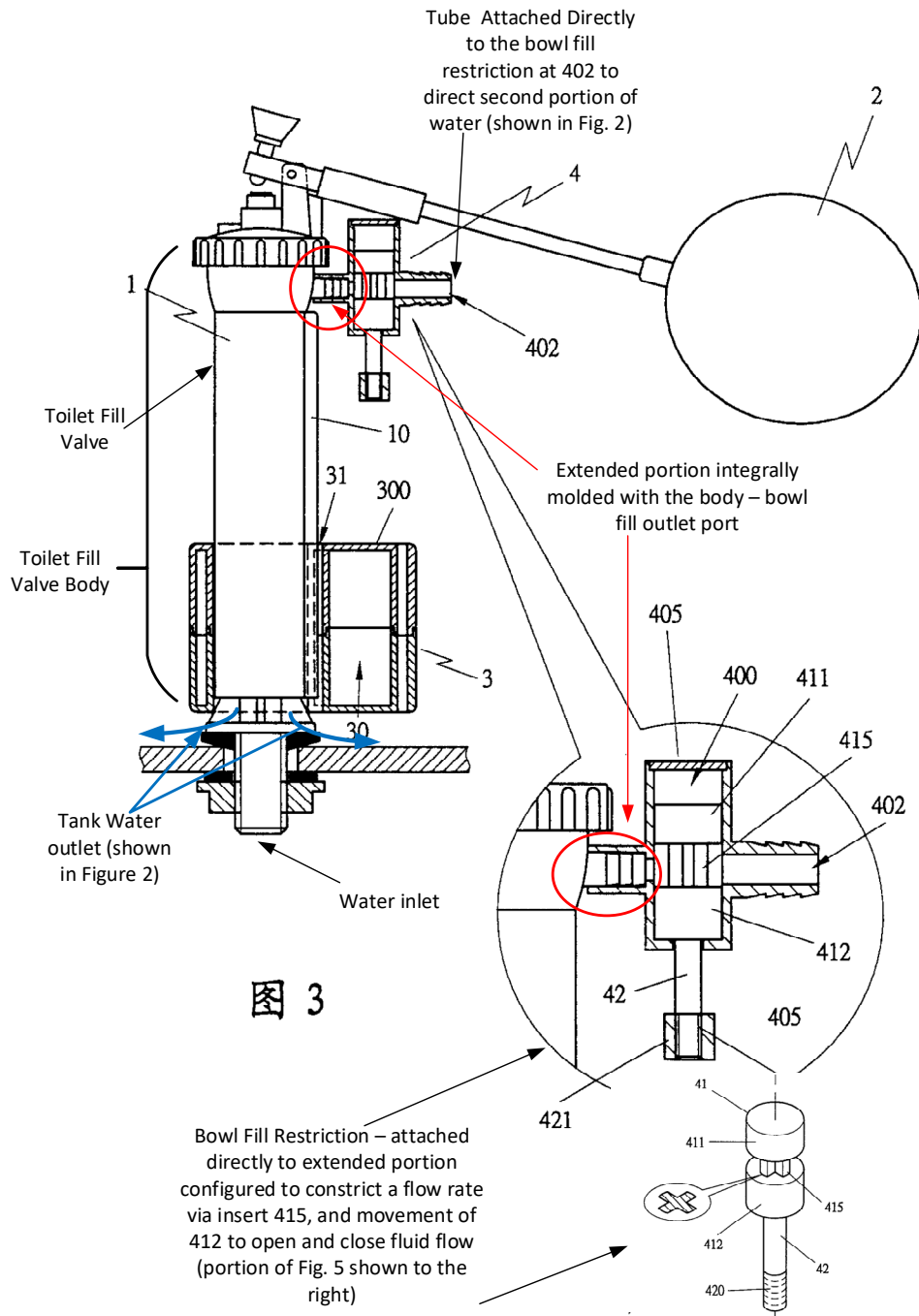
117. The toilet fill valve connectors at issue here are likewise interchangeable. Thus, a toilet fill valve with a male connector that mates to a female connector on a bowl fill restriction (as in Guoxin) is equivalent to a toilet fill valve with female connector that mates to a male connector on a bowl fill restriction (as in

Ho and the '105 patent). Indeed the '105 patent confirms the obvious interchangeability of protrusions, ribs, recesses, etc., on the respective couplings. '105 patent (EX1001), 7:21-33 (“it is possible that this arrangement may be reversed....in a reverse arrangement”).

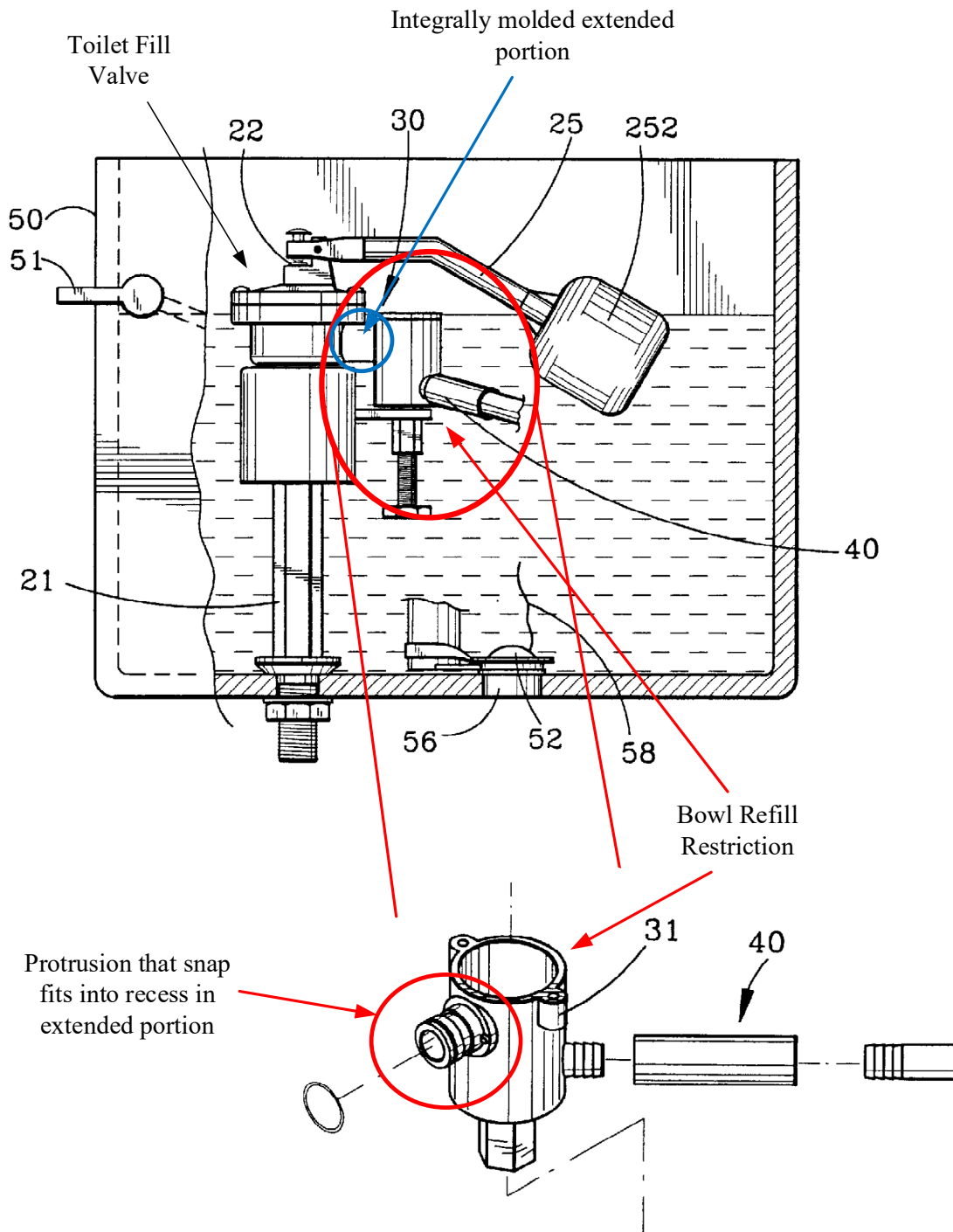
118. In view of the foregoing, using a male connector on the bowl fill restriction, such as the one shown in Ho, instead of the female connector, such as the one shown in Guoxin, would have been obvious to a POSITA as a matter of design preference. They are well-known substitute structures for performing the same function in their known and expected manner and would require only a simple substitution of one known coupling arrangement for another to obtain predictable results.

1. Independent Claims 1 and 24 are Obvious Over Guoxin in View of Ho

119. In connection with my analysis, I refer to the following annotated figures from Guoxin and Ho provided below, and additional annotated figures introduced later.



EX1016 (Guoxin), 2:8-20, Figs. 2-5, Annotated Figs. 3 and 5 above.



EX1022 (Ho), annotated Figs. 2 and 5 above.

a) Claim Elements 1[Pre], 24 [Pre]

120. Claims 1 and 24 each recite “A system, comprising: a toilet fill valve ...; a bowl fill restriction ...; and a tube ...” As illustrated in the annotated figures above, Guoxin and Ho each disclose a system including these three elements.

b) Claim Elements 1[A], 24 [A]

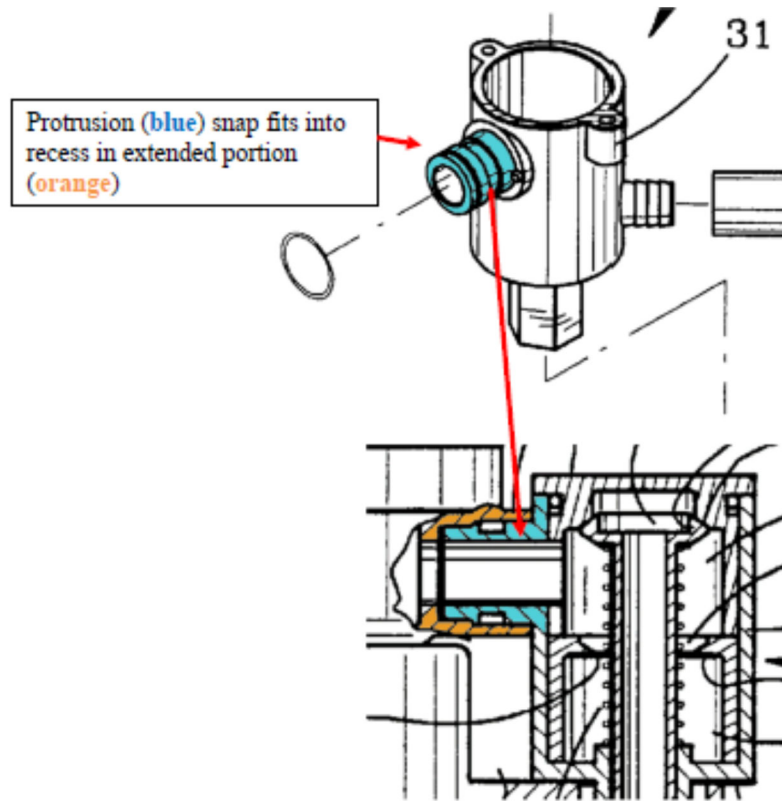
121. Claim element **1[A]** recites “a toilet fill valve that comprises: a body comprising an extended portion, wherein the extended portion is integrally molded with the body, wherein the extended portion forms a bowl fill outlet port....” ’105 patent, claim 1.

122. Similarly, claim element **24[A]** recites “a toilet fill valve that comprises: a body comprising an extended portion that forms a bowl fill outlet port, wherein the extended portion is integrally molded with the body” ’105 patent, claim 24.

123. Guoxin discloses a toilet fill valve having an extended portion that is integrally molded with the water inlet device 1, as shown above in Figure 3 and the exploded view of Figure 4. The extended portion of Guoxin’s toilet fill valve forms a bowl fill outlet port.

124. While Guoxin alone satisfies this element, if PO incorrectly argues that the extended portion illustrated in Guoxin is not “integrally molded,” then Ho clearly discloses an integrally molded extended portion on a toilet fill valve with a recess

into which a bowl fill restriction device with a protrusion is inserted and locked into place. See EX1022, annotated Figs. 3 and 5 below.



125. Integrally molding the extended portion of Guoxin with the inlet device as taught by Ho would be advantageous in improving the strength and integrity of the connection, and to make it easier to manufacture and assemble. Thus, it would have been obvious to integrally mold the extended portion of Guoxin with the inlet device as taught by Ho achieve these benefits.

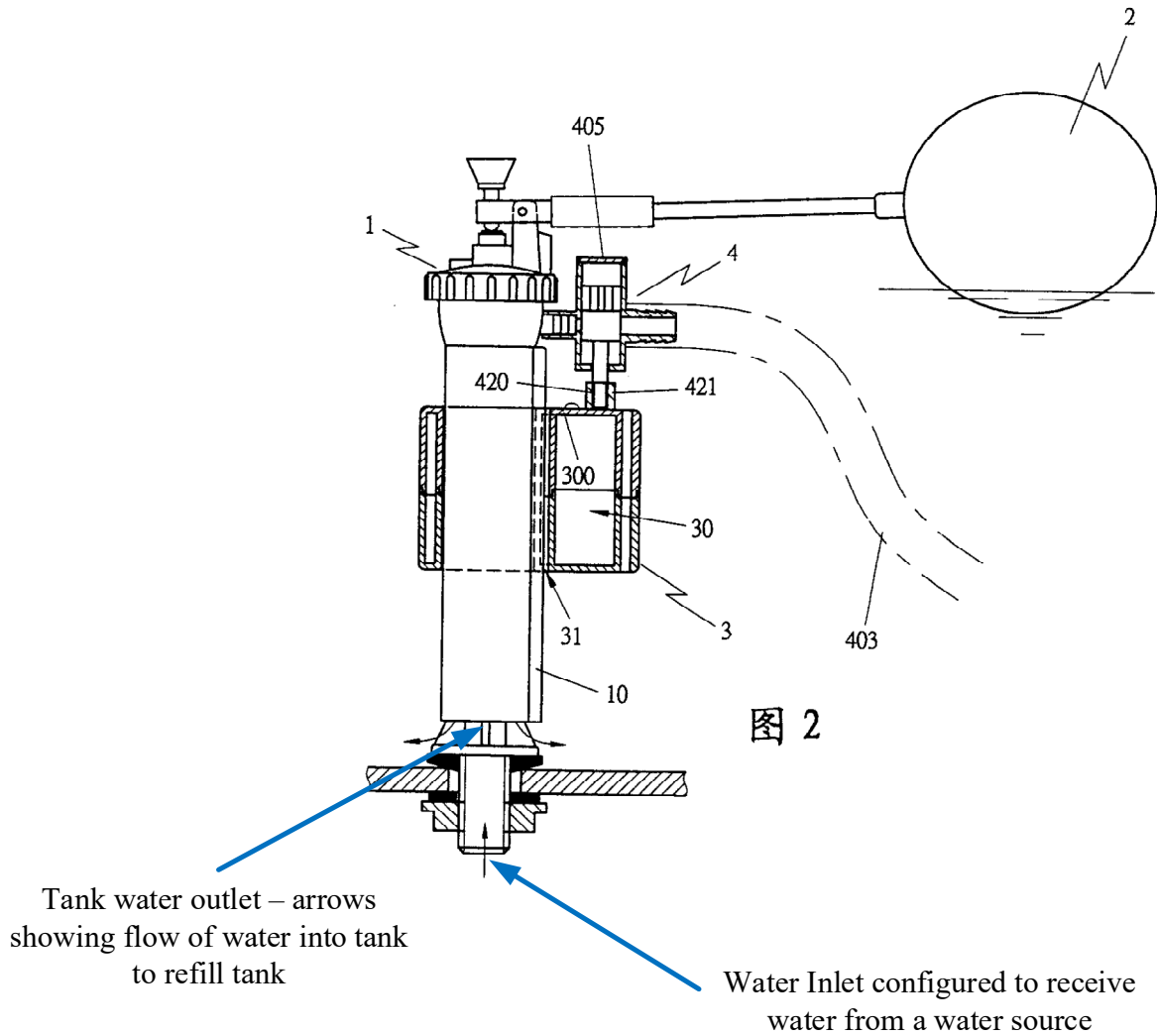
126. In view of the foregoing, Guoxin, and the combination of Guoxin and Ho, satisfy elements 1[A] and 24[A].

c) Claim Elements 1[B], 24[B]

127. Claim element **1[B]** recites “a water inlet configured to receive water from a water source...” ’105 patent, claim 1.

128. Claim element **24[B]** also recites “a water inlet configured to receive water from a water source” ’105 patent, claim 24.

129. Guoxin discloses a water inlet device 1 configured to receive water from a water source. *See* Guoxin (EX1016), 2:8-9. Ho discloses a water supplying pipe 21 configured to receive water from a water source. *See* Ho (EX1022), 2:56. Thus, Guoxin and Ho each discloses a water inlet, as is conventional in the art, configured to receive water from a water source. Further, annotated Guoxin (EX1016) Figure 2 below includes an arrow pointing upward (black arrow in original) that shows the flow of water into water inlet device 1.



130. In view of the foregoing, Guoxin and Ho each satisfy these elements.

d) Claim Elements 1[C], 24[C]

131. Claim element 1[C] recites “a tank water outlet configured to provide a first portion of the water to a toilet tank during at least a portion of a flush cycle....” ’105 patent, claim 1.

132. Claim element **24[C]** also recites “a tank water outlet configured to provide a first portion of the water to a toilet tank during at least a portion of a flush cycle....” ’105 patent, claim 24.

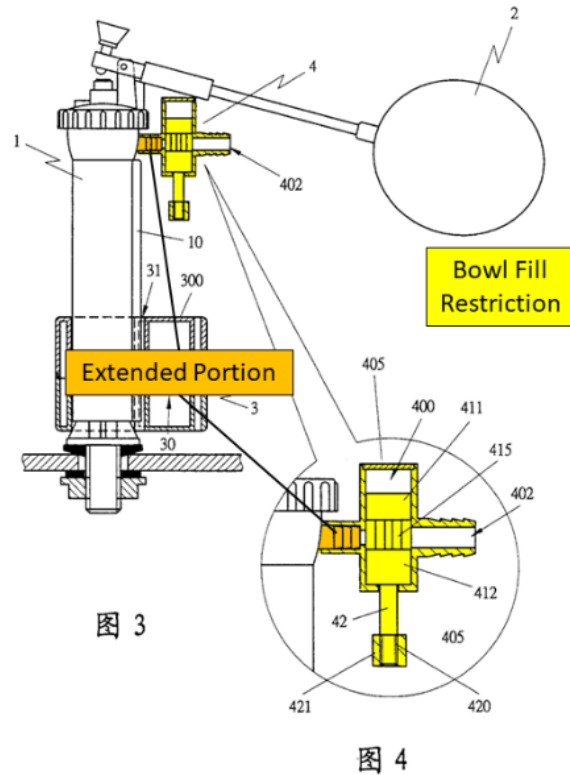
133. Guoxin illustrates the tank water outlet as shown in annotated Figure 2 above. Ho discloses tank water outlet via passage 321 of valve rod 32. *See* Ho (EX1022), 4:32-39, Fig. 10. As such, Guoxin and Ho each disclose a tank water outlet, as is conventional in the art, and satisfy these elements.

e) Claim Elements 1[D1], 24[D1]

134. Claim element **1[B]** recites “a bowl fill restriction configured to attach directly to the extended portion of the body....” ’105 patent, claim 1.

135. Claim element **24[D1]** also recites “a bowl fill restriction configured to attach directly to the extended portion of the body of the toilet fill valve....” ’105 patent, claim 24.

136. Guoxin discloses a bowl fill restriction in the form of switching mechanism 4 that attaches directly to the extended portion of the body of the toilet fill valve via the mating engagement of switching valve inlet 401, and the ridged protrusion (extended portion) on water inlet device 1. *See* Guoxin (EX1016), 2:8-20, Figs. 2-5; *see also*, Guoxin annotated Figs. 3-5 below.



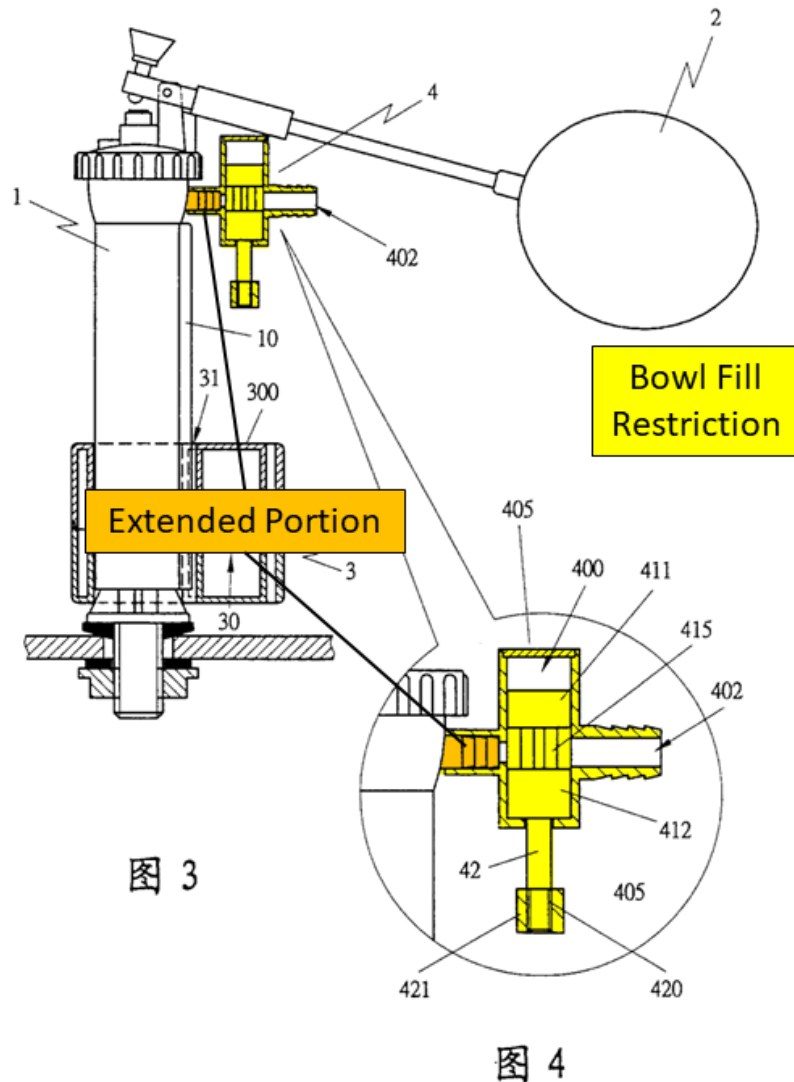
137. Ho discloses bowl fill restriction 30 (diverter valve means) that attaches directly to the extended portion of the toilet fill valve. *See* Ho (EX1022), 3:8-13, Fig. 5 and 8-11.

138. In view of the forgoing, Guoxin and Ho each satisfy these elements.

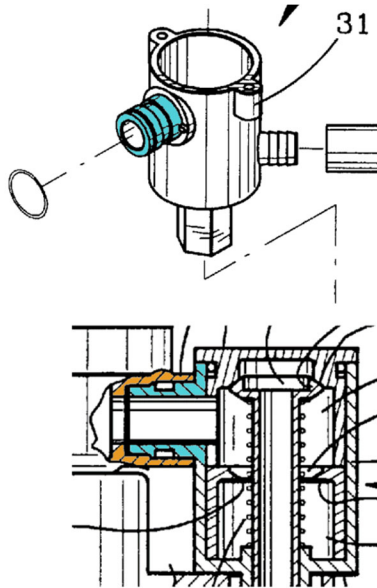
f) Claim Element 1[D2]

139. Claim element 1[D2] recites “wherein the bowl fill restriction comprises a protrusion that is configured to insert into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the body....” ’105 patent, claim 1.

140. Guoxin discloses a protrusion that is configured to insert into a recess in inlet 401 of bowl fill restriction, and its ridges or protrusions lock within inlet 401. See Guoxin (EX1016), annotated Figs. 3 and 4 below.



141. Ho discloses a protrusion configured to fit into a recess in the extended portion of the toilet fill valve, which is simply the reverse mating engagement as that shown by Guoxin. See Ho (EX1022), annotated Figs. 3 and 5 below.



142. As explained above in Section VIII.B, it would have been obvious to use the mating engagement of Ho to attach the extended portion of Guoxin's toilet fill valve with switching mechanism 4 of Guoxin, as a simple substitution of one known coupling arrangement for another to obtain predictable results.

143. I note that the obviousness of such a substitution is also supported by the prosecution of the grandchild '698 patent, where PO presented claim 3, which recited the precise arrangement disclosed by Guoxin (e.g., male protrusion as the bowl fill outlet port and female receptacle at the bowl fill inlet port) and referred to paragraphs [0033] and [0042] of the specification as support. Prosecution History for the '698 Patent (EX1006), 80-81. In particular, Paragraph [0033] states:

...the bowl fill outlet port 206 may comprise a female receptacle and, correspondingly, the bowl fill valve inlet port 213 may comprise a male end compatible with a female receptacle. Alternatively, the bowl fill valve inlet

port 213 may comprise a female receptacle and the bowl fill outlet port 206 may comprise a male end compatible with such female receptable.

Id.

144. Paragraph [0042] also states with respect to the connectors shown in Figs. 5A and 5B that “**it is possible that this arrangement may be reversed....**”

Id. (emphasis in original). It is clear from the ’105 patent specification and the intrinsic evidence that PO placed no criticality on which portion of the coupling was the male portion and which portion was the female portion. Placing a protrusion on the bowl fill restriction or on the toilet fill valve bowl fill outlet port therefore would have been an obvious design choice to a POSITA.

145. Accordingly, the combination of Guoxin and Ho renders obvious a protrusion on a bowl fill restriction that snaps or locks into a recess in an integrally molded extended portion of the toilet fill valve, thereby satisfying this element.

g) Claim Element 24[D2]

146. Claim element **24[D2]** recites “wherein the bowl fill restriction comprises means for locking the bowl fill restriction to the extended portion of the body of the toilet fill valve....” ’105 patent, claim 24.

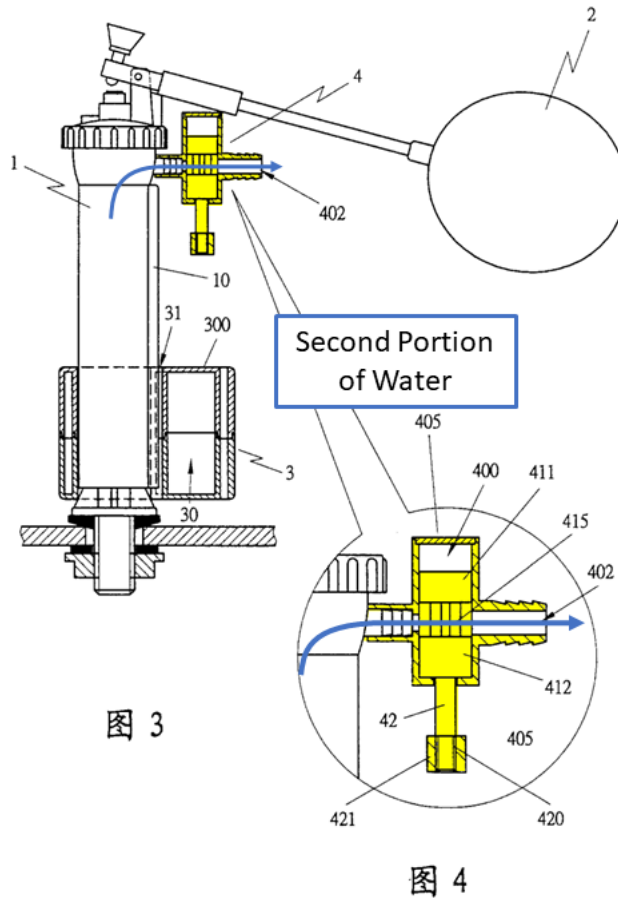
147. My discussion of claim element **1[D2]** applies here as well. As discussed above, Guoxin and Ho disclose means for locking the bowl fill restriction to the extended portion. As such, Guoxin in view of Ho therefore satisfies this element.

h) Claim Elements 1[D3], 24[D3]

148. Claim element **1[D3]** recites “wherein the bowl fill restriction is configured to receive a second portion of the water from the bowl fill outlet port during at least a portion of the flush cycle....” ’105 patent, claim 1.

149. Claim element **24[D3]** also recites “wherein the bowl fill restriction is configured to receive a second portion of the water from the bowl fill outlet port during at least a portion of the flush cycle....” ’105 patent, claim 24.

150. Guoxin illustrates a first portion of water exiting water inlet device 1 at the bottom (radially extending downward arrows in Figure 2), and a second portion exiting through the extended portion and into switching mechanism 4 via inlet 401. *See also*, Guoxin (EX1016), annotated Figs. 3-4 below.



151. Ho discloses a first portion of water that exits through tube 32 to refill the tank (Fig. 10 below), and a second portion of water that exits through toilet bowl refill tube 40 (not shown in Fig. 10) via water flowing through valve seat 311 into chamber 31.

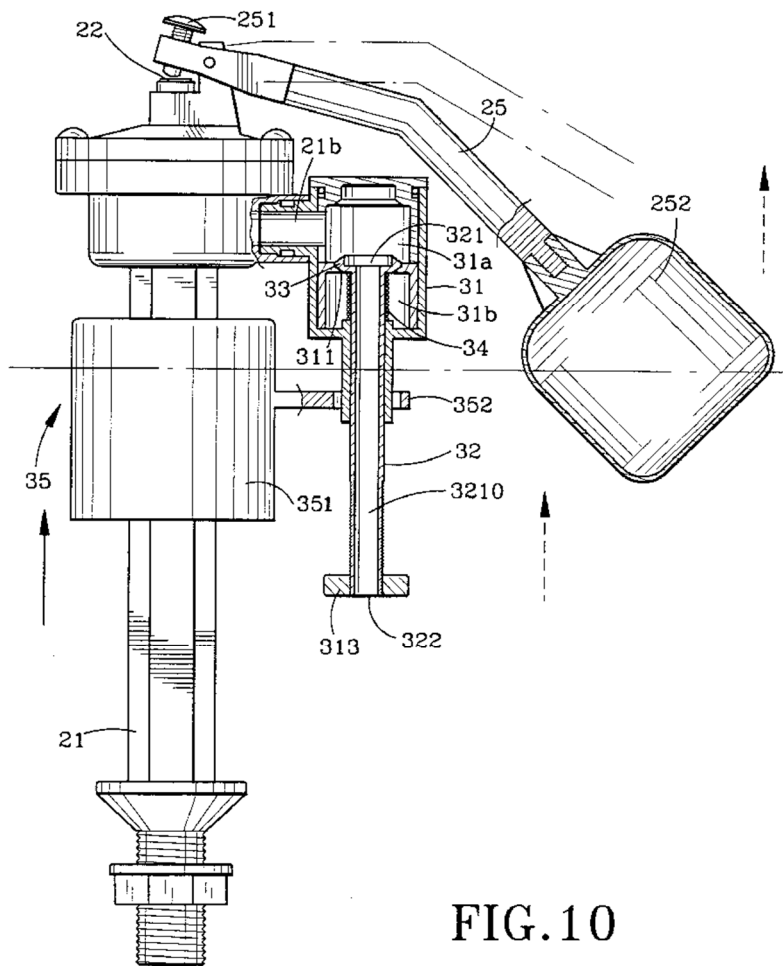


FIG. 10

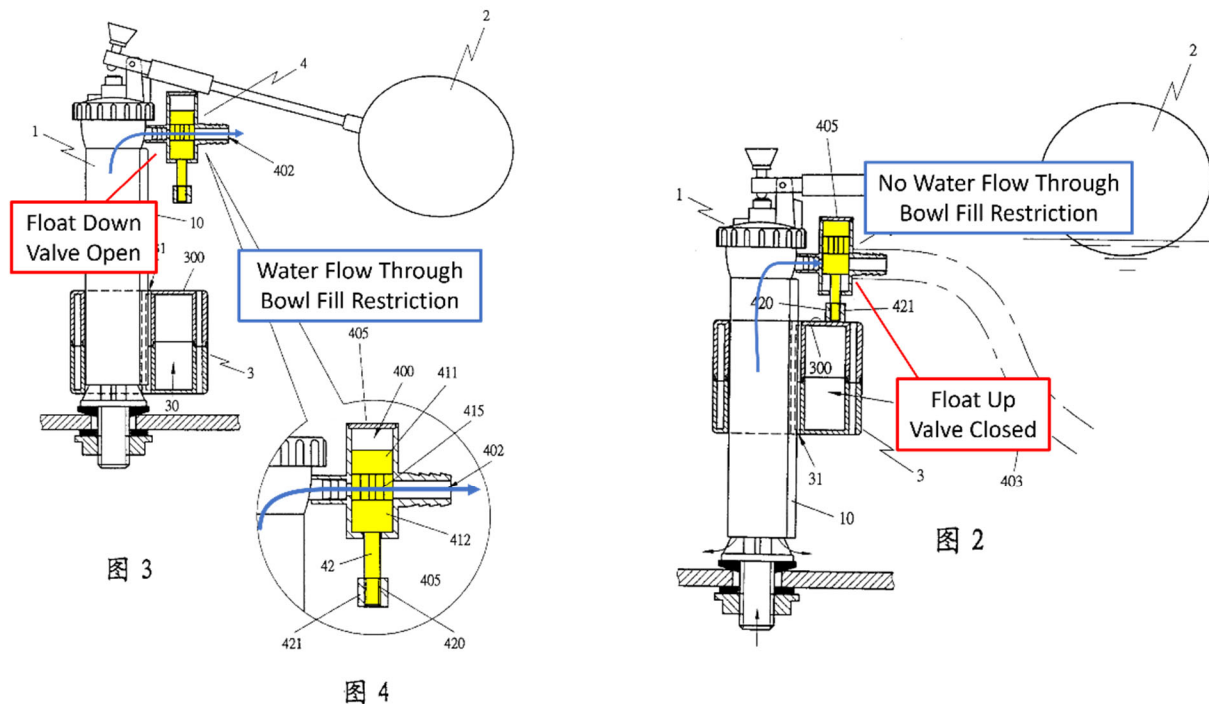
152. In view of the foregoing, Guoxin and Ho each satisfies these elements.

i) Claim Elements 1[D4], 24[D4]

153. Claim element 1[D4] recites “wherein the restriction is configured to constrict a flow rate of the second portion of the water that flows through the bowl fill restriction....” ’105 patent, claim 1.

154. Claim element 24[D4] also recites “wherein the restriction is configured to constrict a flow rate of the second portion of the water that flows through the bowl fill restriction....” ’105 patent, claim 24.

155. Guoxin discloses ring 415 that constricts the flow of water, as well as lower annular surround 412 that gradually rises upward in switching valve 41 as the water rises in the tank to reduce and eventually close the flow of water into the toilet bowl via water outlet 402. Guoxin (EX1016), 2:25-27, Figs. 2-5; *see also*, annotated Figs. 2-4 below.



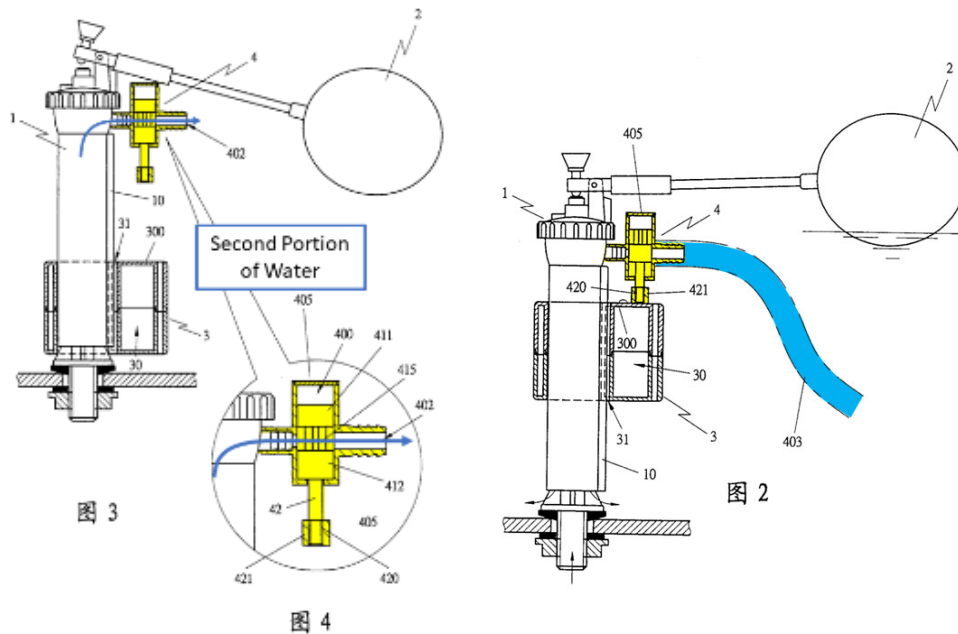
156. In view of the foregoing, Guoxin satisfies these elements.

j) Claim Elements 1[E], 24[E]

157. Claim element 1[E] recites “a tube that is configured to attach directly to the bowl fill restriction, wherein the tube is configured to direct the second portion of the water from the bowl fill restriction directly to a toilet tank overflow tube.” ’105 patent, claim 1.

158. Claim element **24[E]** also recites “a tube configured to attach directly to the bowl fill restriction, wherein the tube is configured to direct the second portion of the water from the bowl fill restriction to a toilet tank overflow tube.” ’105 patent, claim 24.

159. Guoxin discloses a tube configured to attach directly to the bowl fill restriction to direct the second portion of water to a toilet tank overflow tube, as is conventional in the art. *See* annotated figure of Guoxin illustrated above regarding claim elements **1[Pre]** and **24[Pre]** and annotated Figs. 2-4 below.



160. As shown above, Guoxin discloses tube 403 (Fig. 2), that is configured to provide water supply to the toilet bowl. Guoxin (EX1016), 2:17-18. In view of the foregoing, Guoxin therefore satisfies these elements.

k) Summary of Opinions Regarding Independent Claims 1 and 24

161. The only element of independent claims 1 and 24 not expressly disclosed by Guoxin is an extended portion containing a recess that mates with a corresponding protrusion of the switching mechanism 4. However, switching or reversing the mating surfaces (recess and protrusion) to one or the other fluid conduits is merely a matter of design preference, and would have been obvious to a POSITA. *See, e.g.,* Bjerke (EX1017), 7:15-24, Figs. 5-6 (reproduced below showing that male and female connectors can be reversed in relation to each other and are thus interchangeable).

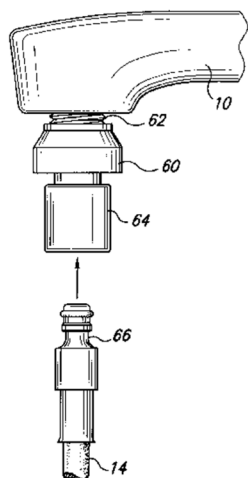


Fig. 5

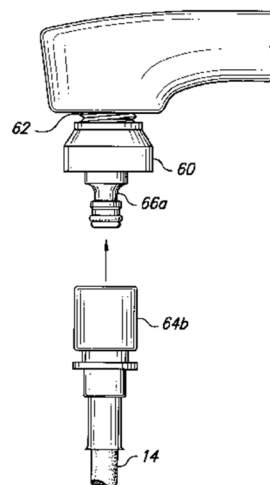


Fig. 6

162. Indeed, the '105 patent acknowledges the obvious interchangeability of protrusions, ribs, recesses, etc., on the respective couplings. '105 patent (EX1001), 7:21-33 ("it is possible that this arrangement may be reversed....in a reverse arrangement"). The '105 patent also contemplates the use of any of a variety of well-

known snap fit and sealing configurations: “Also, other snap fit and sealing configurations may be employed beyond those specifically described herein.” *Id.*, 9:52-53. Finally, as discussed above in my analysis of claims 1 and 24, Ho discloses this feature of the claims.

163. In view of the foregoing, Guoxin alone, or Guoxin in view of Ho renders obvious independent claims 1 and 24.

2. Independent Claim 9 is Obvious Over Guoxin in View of Ho

164. Independent claim 9 is fundamentally nothing more than the method (steps) performed when using the system of claims 1 and 24. As such, claim 9 is obvious over Guoxin in view of Ho for the generally the same reasons as claims 1 and 24 are obvious as described above.

a) Claim Elements 9[Pre], 9[A]

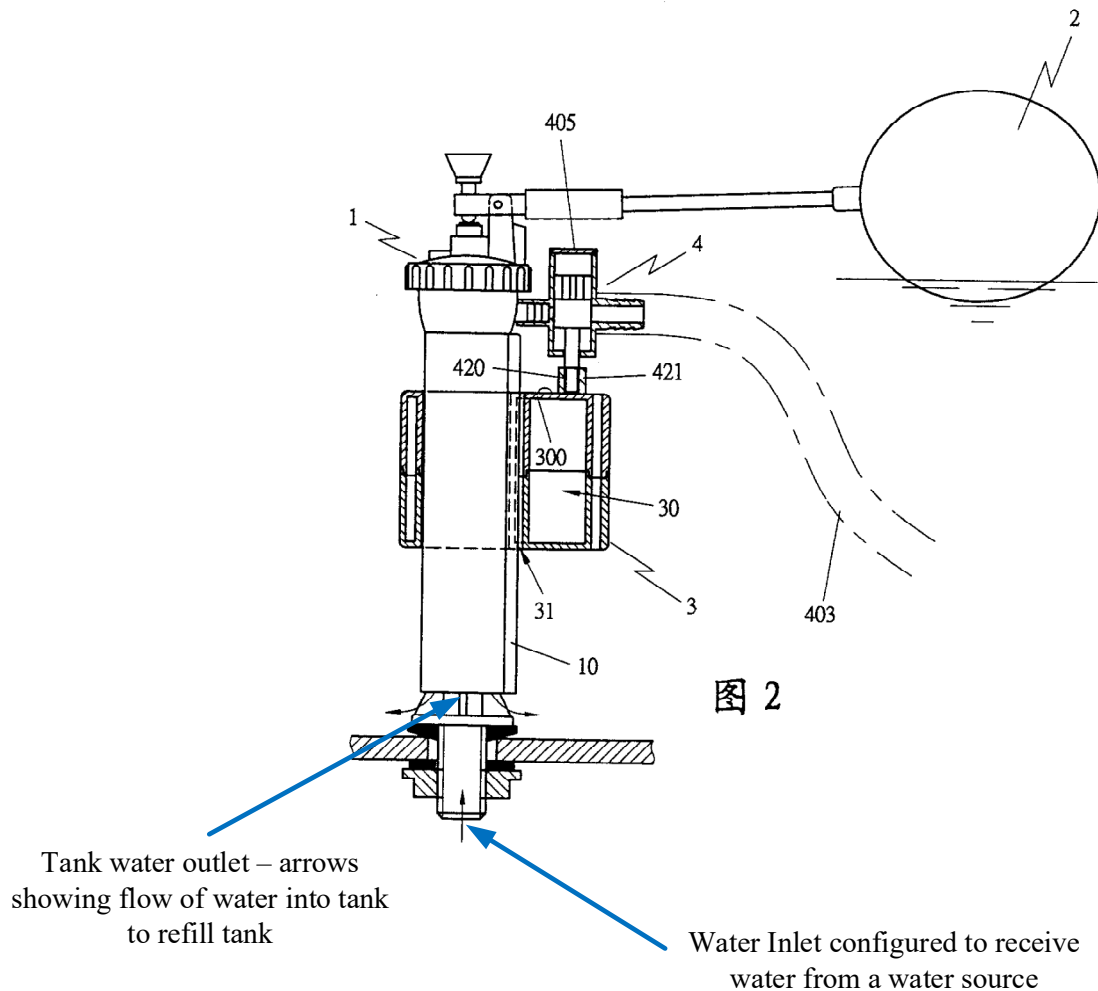
165. Claim elements **9[Pre]** and **9[A]** recite, respectively, “[a] method, comprising” and “receiving, via a water inlet of a toilet fill valve, water from a water supply.” ’105 patent, claim 9.

166. In addition to the discussion of claim elements **1[B]** and **24[B]** above, I note that Guoxin discloses a water inlet device 1 that includes a conventional ball float 2 “to control whether or not the water inlet device admits water,” as shown by the upward pointing arrow at the bottom of Figure 2. *See* Guoxin (EX1016), 2:8-10. In view of the foregoing, Guoxin satisfies these elements.

b) Claim Element 9[B]

167. Claim element **9[B]** recites “providing, via a tank water outlet of the toilet fill valve, a first portion of the water to a toilet tank....” ’105 patent, claim 9.

168. In addition to the discussion of **1[C]** and **24[C]** above, I note that in operation, Guoxin discloses this claim element. Guoxin illustrates a first tank water outlet as shown by the downwardly and radially extending arrows at the bottom of Figure 2 below. *See* Guoxin (EX1016). In view of the foregoing, Guoxin satisfies this element.

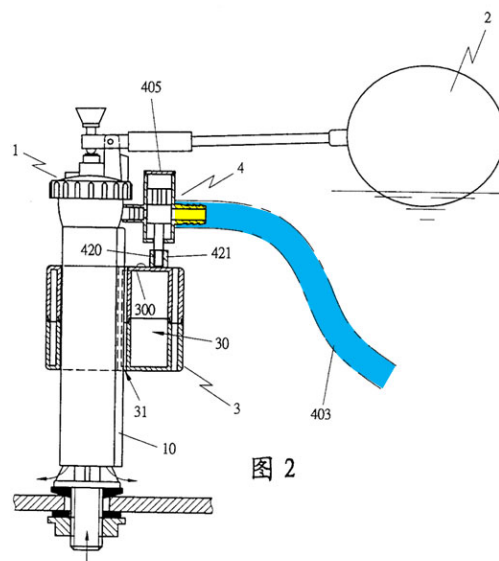


c) Claim Element 9[C1]

169. Claim element 1[C1] recites “providing, via a bowl fill outlet port of the toilet fill valve, a second portion of the water to a bowl fill restriction, wherein an extended portion of the toilet fill valve forms the bowl fill outlet port....” ’105 patent, claim 1.

170. In addition to the discussion of 1[D3] and 24[D3] above, I note that Guoxin discloses water being supplied from water inlet 1 into switching mechanism

4 as a second portion of water to be supplied to the toilet bowl via switching mechanism 4. The first and major portion flows downwardly into tank through the water inlet valve body 1, and the remainder, or second portion, flows through the extended portion through inlet 401 of the bowl fill restriction. Guoxin (EX1016), 2:8-20, Figs. 2-5, annotated Fig. 2 below. In view of the foregoing, Guoxin satisfies this element.

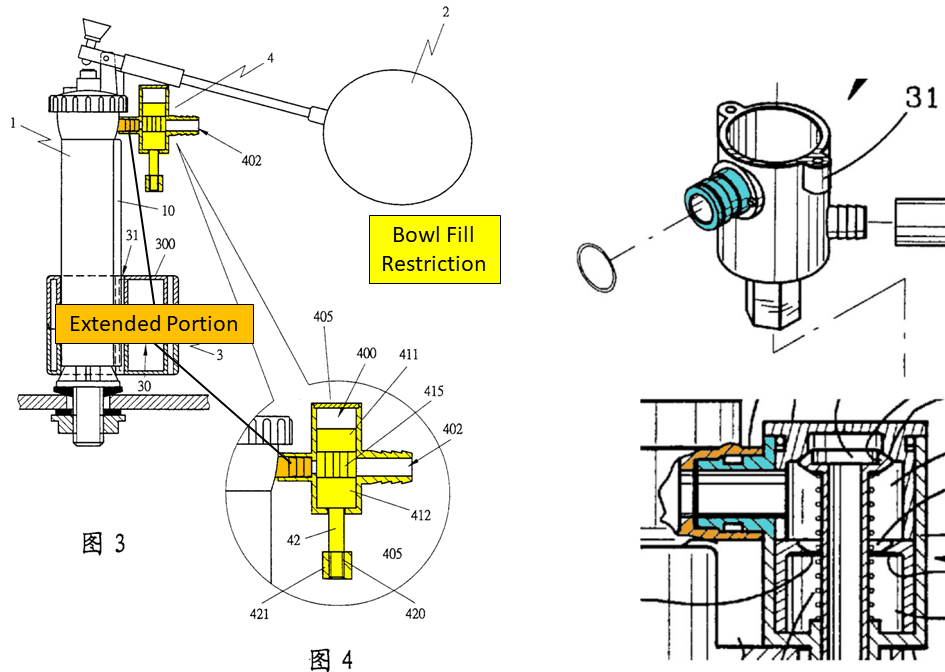


d) Claim Element 9[C2]

171. Claim element 9[C2] recites “wherein the extended portion is integrally molded with the toilet fill valve...” ’105 patent, claim 9.

172. In addition to the discussion of 1[A] and 24[A] above, I note that both Guoxin and Ho disclose and illustrate radially extending extended portions integrally molded with the toilet valve body. Annotated Figures 3 and 4 of Guoxin and

annotated Figure 3 and 5 of Ho, both reproduced below, show the radially extending extended portions colored in orange. In view of the foregoing, Guoxin, and the combination of Guoxin and Ho, satisfies this element.



e) Claim Element 9[C3]

173. Claim element 9[C3] recites “wherein the bowl fill restriction is in direct contact with the extended portion of the toilet fill valve...” ’105 patent, claim 9.

174. Guoxin’s switching mechanism 4 attaches directly to the extended portion of toilet fill valve. *See* Guoxin (EX1016), Fig. 4. Similarly, Ho illustrates bowl fill restriction 30 (diverter valve means) attached directly to the extended

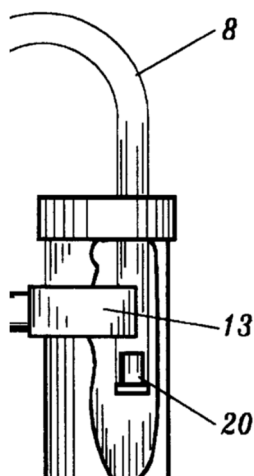
portion of the toilet fill valve. *See* Ho (EX1022), Figs. 3, 4 and 6-11. Thus, Guoxin, and the combination of Guoxin and Ho, satisfies this element.

f) Claim Element 9[C4]

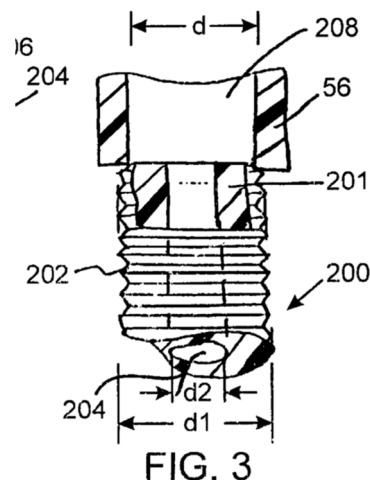
175. Claim element 9[C4] recites “wherein the bowl fill restriction is constructed as a single piece...” ’105 patent, claim 9.

176. The figures of Guoxin and Ho show Guoxin’s switching mechanism 4 and Ho’s diverter valve 30 as unitary structures. This is similar to the valve shown in the embodiments of the ’105 patent that have a movable handle. Furthermore, claim 3 of Guoxin specifically recites that the switching mechanism 4 and valve stem (together the bowl fill restriction) are “integrally formed, making assembly and combination exceedingly convenient and fast.” Guoxin (EX1016), 3:3-4. As such, to the extent that Guoxin’s switching mechanism 4 and Ho’s diverter valve 30 are not considered to be “constructed as a single piece,” constructing them as a single piece would have been an obvious matter of design preference to a POSITA. Indeed, a POSITA would understand that having the bowl fill restriction as a single piece would be advantageous in that assembly of the bowl fill restriction and toilet fill valve would simply require snapping or pressing the two pieces together. Examples of bowl fill restrictions being constructed as a single piece are also found throughout the prior art, such as in Williams (EX1027, Fig. 1 reproduced below) and Alles

(EX1028, Fig. 3 reproduced below). Accordingly, this element would have been obvious in view of the prior art.



EX1027 (Williams), 3:8-17, Fig. 1.



EX1028 (Alles), 3:6-36, Fig. 3.

g) Claim Element 9[C5]

177. Claim element 9[C5] recites “wherein the bowl fill restriction causes a flow of the second portion of the water to be constricted....” ’105 patent, claim 9.

178. Guoxin satisfies this element for the same reasons discussed in 1[D4] and 24[D4] above.

h) Claim Element 9[D]

179. Claim element 9[D] recites “providing, via the bowl fill restriction, the second portion of the water to a tube that is in direct contact with the bowl fill restriction; and providing, via the tube, the second portion of the water to a toilet tank overflow tube.” ’105 patent, claim 9.

180. Guoxin satisfies this element for the same reasons discussed in **1[D4]** and **24[D4]** above.

i) Summary of Opinions Regarding Independent Claim 9

181. In view of the above discussion, Guoxin and Ho individually or in combination disclose or render obvious all of the elements recited by independent claim 9.

3. Independent Claim 15 is Obvious Over Guoxin in View of Ho

182. Independent claim 15 is obvious over Guoxin in view of Ho for the generally the same reasons as claims 1 and 24 are obvious as described above. Claim 15 is fundamentally nothing more than the method (steps) performed when assembling the system of claims 1 and 24. Regarding assembly, toilet fill valves have been made easier to assemble and replace by homeowners, and consequently, toilet fill valve replacement kits were readily available at hardware and home improvement stores long before the earliest effective filing date of the '105 patent. Fabricating various parts separately and designing the separate parts for easy assembly would have been considered obvious design parameters and/or obvious and routine optimization to a POSITA prior to the '105 patent filing date. There is nothing unique, unexpected, or unobvious in the method steps recited by method 15. Indeed, claim 3 of Guoxin specifically recites that the switching mechanism 4 and

valve stem (together the bowl fill restriction) are “integrally formed, *making assembly and combination exceedingly convenient and fast.*” Guoxin (EX1016), 3:3-4, emphasis added.

a) Claim Element 15[Pre]

183. Claim element **15[Pre]** recites “[a] method, comprising....” ’105 patent, claim 15.

184. To the extent any of the respective pieces of the toilet fill valve and bowl fill restrictions disclosed by Guoxin and Ho are assembled prior to operation of the toilet fill valve, the cited art inherently discloses a method of assembling the respective parts. As noted above, claim 3 of Guoxin specifically recites that the bowl fill restriction (switching mechanism 4 and valve stem) are “integrally formed, making assembly and combination exceedingly convenient and fast.” Guoxin (EX1016), 3:3-4.

b) Claim Element 15[A1]

185. Claim element **15[A1]** recites “attaching a bowl fill restriction directly to an extended portion of a body of a toilet fill valve, wherein the extended portion is integrally molded with the body....” ’105 patent, claim 15.

186. For the same reasons discussed above with respect to elements **1[A]**, **24[A]** **1[D1]**, **24[D1]**, **9[C2]**, and **9[C3]**, Guoxin alone or in view of Ho disclose or renders obvious this element.

c) Claim Element 15[A2]

187. Claim element **15[A2]** recites “wherein the extended portion forms a bowl fill outlet port, wherein the bowl fill restriction is configured to constrict a flow rate of water that flows out of the bowl fill outlet port” ’105 patent, claim 15.

188. This claim element does not further limit this method claim, and prior art that restricts or diverts fluid flow away from the bowl fill outlet port will inherently satisfy this element. For the same reasons discussed above with respect to elements **1[A]**, **24[A]**, **1[D4]**, **24[D4]**, and **9[C5]**, Guoxin and Ho disclose or render obvious this element.

d) Claim Element 15[B]

189. Claim element **15[B]** recites “inserting a protrusion of the bowl fill restriction into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the body....” ’105 patent, claim 15.

190. For the same reasons discussed above with respect to element **1[D2]** above, the combination of Guoxin and Ho renders obvious this element.

e) Claim Element 15[C]

191. Claim element **15[C]** recites “attaching a tube directly to the bowl fill restriction, wherein the tube is configured to direct the water from the bowl fill restriction directly to a toilet tank overflow tube.” ’105 patent, claim 15.

192. In addition to the discussion of elements **1[E]**, **24[E]**, and **9[D]** above, I note that directing a second portion of water to a toilet tank overflow tube is

conventional in the art and disclosed by Guoxin. Thus, Guoxin satisfies this element for the same reasons discussed above regarding 1[E], 24[E], and 9[D].

f) Summary of Opinions Regarding Independent Claim 15

193. Guoxin and Ho individually or in combination disclose or render obvious all of the elements recited by independent claim 15.

4. Dependent claims 2-3, 6, 8, 10-14, and 16-23 are Obvious over Guoxin in view of Ho

a) Claim 2

194. Dependent claim 2 recites “[t]he system of claim 1, wherein the extended portion of the body extends radially from a longitudinal axis of the toilet fill valve.” ’105 patent, claim 2.

195. Both Guoxin and Ho disclose an extended portion extending radially from a longitudinal axis of the fill valve. Guoxin (EX1016), Fig. 1; Ho (EX1022), Figs. 3 and 6-11. As such, Guoxin in view of Ho renders obvious claim 2.

b) Claim 3

196. Dependent claim 3 recites “[t]he system of claim 1, wherein a portion of the bowl fill restriction is configured to insert into the extended portion of the body.” ’105 patent, claim 3.

197. Dependent claim 3 does not further limit claim 1 and recites the same limitation as recited by 1[D2]. To the extent claim 3 further limits claim 1, Guoxin

in view of Ho renders obvious the features of claim 3 for the same reasons discussed above with respect to element 1[D2].

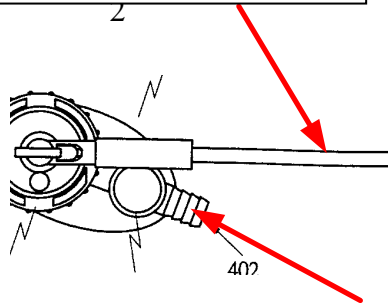
c) Claim 6

198. Claim 6 recites “[t]he system of claim 1, wherein the toilet fill valve further comprises: a float; and an actuating arm coupled to the float, wherein the actuating arm extends radially relative to a longitudinal axis of the toilet fill valve, wherein the actuating arm is angularly offset relative to the bowl fill valve, thereby preventing an interference with the bowl fill restriction and a translational stem that extends from the float to a free end of the actuating arm.” ’105 patent, claim 6.

199. Dependent claim 6 recites a conventional float coupled to an actuating arm in which the actuating arm is angularly offset relative to the bowl fill valve to prevent interference with the bowl fill restriction and a translational stem. The features recited by claim 6 are disclosed and illustrated in each of Guoxin and Ho, and would have been obvious to a POSITA—who would not seek to design a toilet fill valve with a conventional float attached to a translational arm that was obstructed in some manner from freely translating. *See* Guoxin (EX1016), Fig. 1 below; Ho (EX1022), Fig. 6 below.

Guoxin

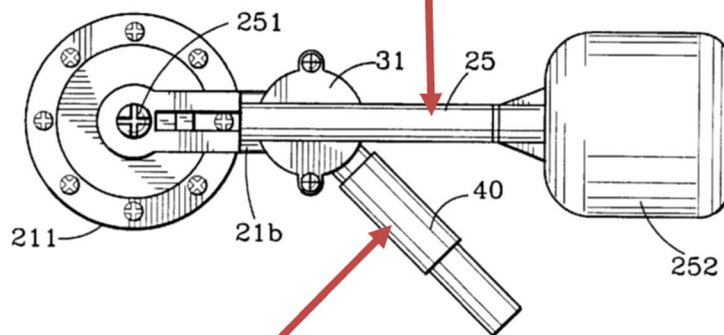
Translation stem connecting float
to actuating arm



Bowl fill restriction attaches here
offset at an angle from float arm

Ho

Translation stem connecting float
to actuating arm



Bowl fill restriction attaches here
offset at an angle from float arm

B.
offset at an angle from float arm

200. Guoxin and Ho disclose the features of dependent claim 6, thereby rendering this claim obvious.

d) Claim 8

201. Claim 8 recites “[t]he system of claim 1, wherein the bowl fill restriction being attached directly to the extended portion of the body prevents a pressure head from being formed in the tube.” ’105 patent, claim 8.

202. Dependent claim 8, to the extent it recites a limitation, merely recites the inherent feature and function of preventing a pressure head formed in the outlet tube. The ’105 patent states that the direct connection, without an intervening hose or tube, prevents the pressure head. ’105 patent (EX1001), 4:3-6. Given that the ’105 patent defined “integral” as either molded as a single piece or connected directly to one another, Guoxin and Ho each inherently discloses the elements of claim 8 by virtue of the direct connection between the bowl fill restriction and the extended portion of the toilet fill valve.

e) Claim 10

203. Claim 10 recites “[t]he method of claim 9, wherein the bowl fill restriction being in direct contact with the extended portion of the toilet fill valve prevents a pressure head from being formed in the tube.” ’105 patent, claim 10.

204. Dependent claim 10 recites elements similar to dependent claim 8, with the exception that claim 10 depends from method claim 9. For the same reasons discussed above with respect to claim 8, Guoxin and Ho disclose a direct connection

that inherently prevents a pressure head from being formed in the tube and claim 10 is obvious over Guoxin and Ho.

f) Claims 11 and 12

205. Claim 11 recites “[t]he method of claim 9, further comprising terminating, using the toilet fill valve, the flow of the second portion of the water so that a water level in a toilet bowl is at a predefined level.” ’105 patent, claim 11.

206. Claim 12 recites “[t]he method of claim 11, wherein the water level is determined at least in part by the bowl fill restriction.” ’105 patent, claim 12.

207. Dependent claims 11 and 12 recite terminating the flow of the second portion of water using the toilet fill valve so that a water level in a toilet bowl is at a predetermined level (11), where the level is determined at least in part by the bowl fill restriction (12). Guoxin discloses terminating the flow of the second portion of water when the toilet bowl reaches a certain level. Guoxin (EX1016), 2:25-27. That level is set by adjusting the T-shaped nut to change the position of how the switching valve’s stem is driven, which in turn alters the amount of water that can leave the bowl fill restriction before the float valve stops water from entering the water inlet. *Id.*, 2:27-33. Guoxin also discloses a conventional ball cock valve attached to float 2, which controls “whether or not the water inlet device admits water.” *Id.*, 2:8-10. In view of the foregoing, Guoxin therefore satisfies the elements of claims 11 and 12.

g) Claims 13 and 14

208. Dependent claim **13** recites “[t]he method of claim 9, wherein the extended portion of the toilet fill valve is a portion of a body of the toilet fill valve.” ’105 patent, claim 13.

209. Dependent claim **14** recites “[t]he method of claim 9, wherein the extended portion of the toilet fill valve extends radially from a longitudinal axis of the toilet fill valve.” ’105 patent, claim 14.

210. Dependent claim 13 recites the extended portion being a portion of a body of the toilet fill valve, and dependent claim 14 recites the extended portion extending radially from a longitudinal axis. These features are discussed above with reference to elements **1[A]**, **24[A]**, **15[A1]** and claim 2. Thus, claims 13 and 14 are obvious for the same reasons discussed above.

h) Claim 20

211. Dependent claim **20** recites “[t]he method of claim 15, wherein attaching a bowl fill restriction directly to the extended portion of the body of the toilet fill valve further comprises inserting a portion of the bowl fill restriction into the extended portion of the body.” ’105 patent, claim 20.

212. Dependent claim 20 recites inserting a portion of the bowl fill restriction into the extended portion of the toilet fill valve. This feature is fully

disclosed or rendered obvious by Guoxin and Ho, as discussed above with reference to dependent claim 3.

i) Claims 21 and 23

213. Dependent claim **21** recites “[t]he system of claim 1, wherein the bowl fill restriction is constructed of a single piece.” ’105 patent, claim 21.

214. Dependent claim **23** recites “[t]he method of claim 15, wherein the bowl fill restriction is constructed of a single piece.” ’105 patent, claim 23.

215. Dependent claims 21 and 23 depend from claims 1 and 15, respectively, and recite the bowl fill restriction being constructed of a single piece. This feature is recited in element **9[C4]**. For the same reasons discussed above, claims 21 and 23 would have been obvious over the prior art. The features of dependent claims 21 and 23 therefore are obvious over Guoxin in view of Ho.

j) Claim 22

216. Dependent claim **22** recites “[t]he method of claim 9, wherein the bowl fill restriction comprises a protrusion that is configured to insert into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the toilet fill valve.” ’105 patent, claim 22.

217. Dependent claim 22 recites the bowl fill restriction comprising a protrusion that is configured to insert into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the toilet fill valve. The features of

dependent claim 22 are the same as the elements of 1[D2], 24[D2], and claim 7. For the same reasons discussed above, dependent claim 22 is obvious over the prior art.

C. Dependent Claims 4, 5, 7, and 16-19 are Obvious Under 35 U.S.C. §103 Over Guoxin in view of Ho, and Further in View of the Quick Connection Art

218. The connection between the two fluid channels recited by dependent claims 4, 5, 7, and 16-19 are well-known fluid flow connections disclosed by numerous documents such as Bjerke, Calmettes, Hall, and Kimber—the Quick Connection Art.

1. Claims 4 and 5

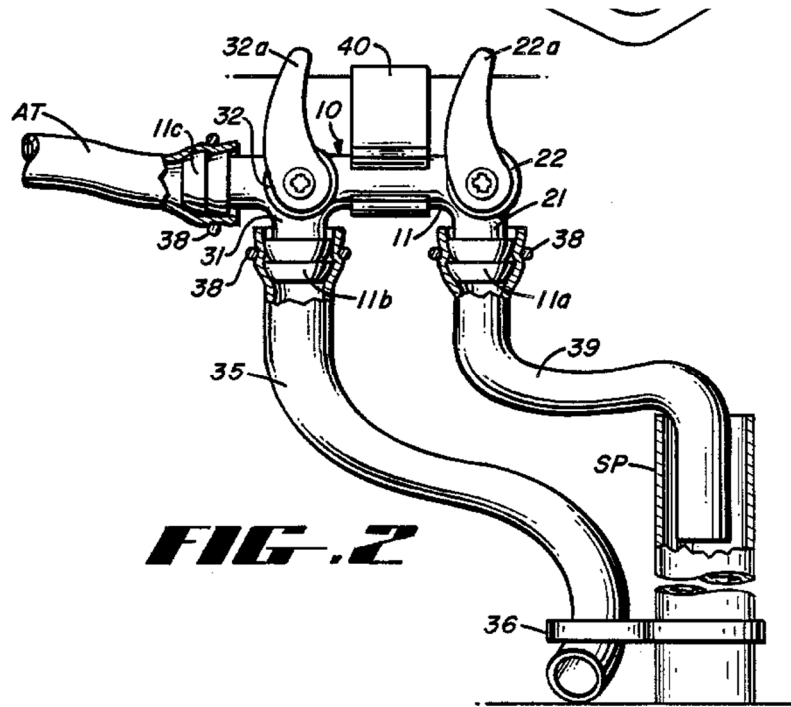
219. Dependent claim 4 recites “[t]he system of claim 1, wherein the bowl fill restriction is configured to be clamped to the extended portion of the body.” ’105 patent, claim 4.

220. Dependent claim 5 recites “[t]he system of claim 1, wherein the bowl fill restriction is configured to be snapped onto the extended portion of the body.” ’105 patent, claim 5.

221. Dependent claims 4 and 5 recite clamping (4) or snapping (5) the bowl fill restriction to the extended portion. To the extent Guoxin in view of Ho does not expressly disclose these mechanisms of attachment, it would have been obvious to a POSITA to use any known method of connecting two fluid channels to one another, such as any of those disclosed in the Quick Connection Art. The ’105 patent does

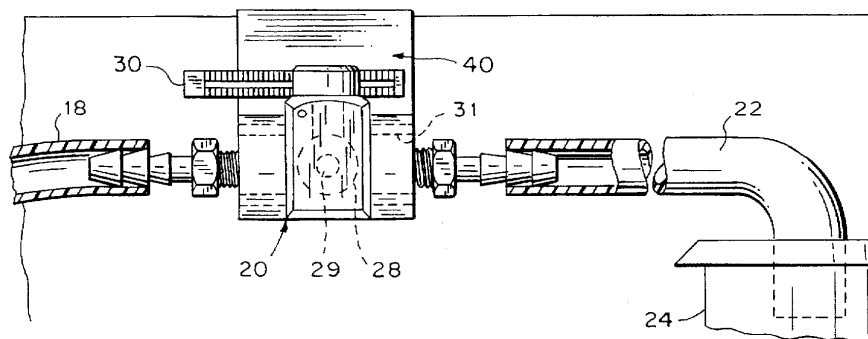
not define the terms “clamping” or “snapping” and uses the term clamping only once with reference to the fluid flow connection between the toilet and bowl fill valves. ’105 patent (EX1001), 2:23-26. Rather, the ’105 patent uses the term “clamping” as generally referring to the use of compressive force. *Id.*, 8:20-26 (“The clamping or compression of the sealing ring 276 pushes the locking ears 266 into the locking position 279 of the locking grooves 269 once the bowl fill valve 203 is rotated accordingly. In this respect, the compressive force of the sealing ring 276 helps keep the bowl fill valve inlet port 213.b of the bowl fill valve 203 mated with the bowl fill outlet port 206b.”). Further, the ’105 patent places no criticality on the particular connection mechanism employed: “...other snap fit and sealing configurations may be employed beyond those specifically described herein.” *Id.*, 9:52-53.

222. Stemples (EX1023) provides an example of how clamps (tube clamps 38) are used to cinch a tube to components by applying compressive force. *See* EX1023, 2:65-66, Fig. 2 (reproduced below).



223. As another example, Horad (EX1025) shows a bowl fill valve (20) connected in-line with the bowl fill tube (22), to adjustably control the flow of water to the overflow tube (24) and into the bowl. *See* EX1025, 2:5-46, Figs. 1-2. As shown in Figure 2 below, valve 20 is friction fit into tube 18 and tube 22. Such a connection necessarily relies upon compressive force, i.e. clamping, in order to maintain the connection.

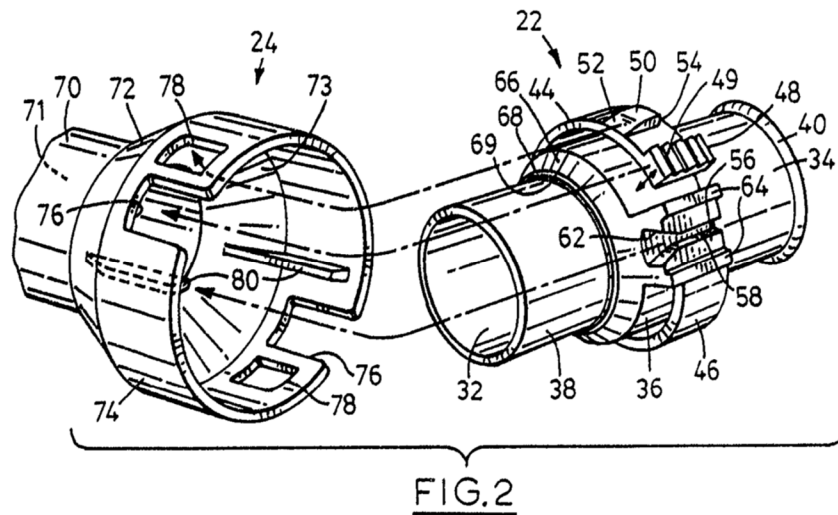
FIG. 2



224. Similarly, the flow control inserts 104 and 105 of Shaw (EX1026) “are retained in bowl fill tube assembly 106, when used, by frictional contact between their outer surface and the inner surface of the tube in which they are inserted.” *See* EX1026, 8:17-20. Such a connection necessarily relies upon compressive force, i.e. clamping, in order to maintain the friction force connection. *See also*, Williams (EX1027), 3:8-17, Fig. 1.

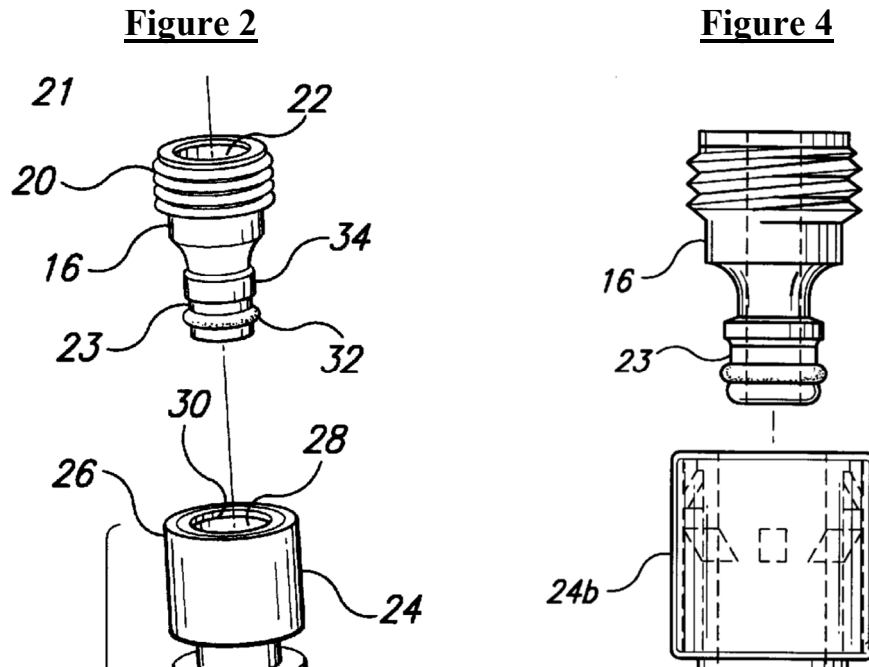
225. Guoxin’s bowl fill restriction is clamped on and over an extended portion, as shown in Figures 2-5, such that a compressive force is exerted on the extended portion in order to maintain a tight connection. Guoxin (EX1016). Such a connection is similar to that of Horad, Shaw, and Williams, all of which rely upon compressive force (i.e., clamping) in order to create the friction necessary to maintain connections with the bowl fill restriction. Guoxin in view of Ho and further in view of the knowledge of a POSITA, therefore renders obvious dependent claim 4.

226. Kimber discloses an arrangement between fluid flow couplings that has the advantage of making the connection between two fluid flow channels easy and detectable by the user by virtue of the male and female fittings snapping together and the use of mating slots, protrusions, projections, and apertures. Kimber (EX1020), 4:17-21. Figure 2 below illustrates the coupling arrangement between male fitting 22 and tubular female fitting 24.

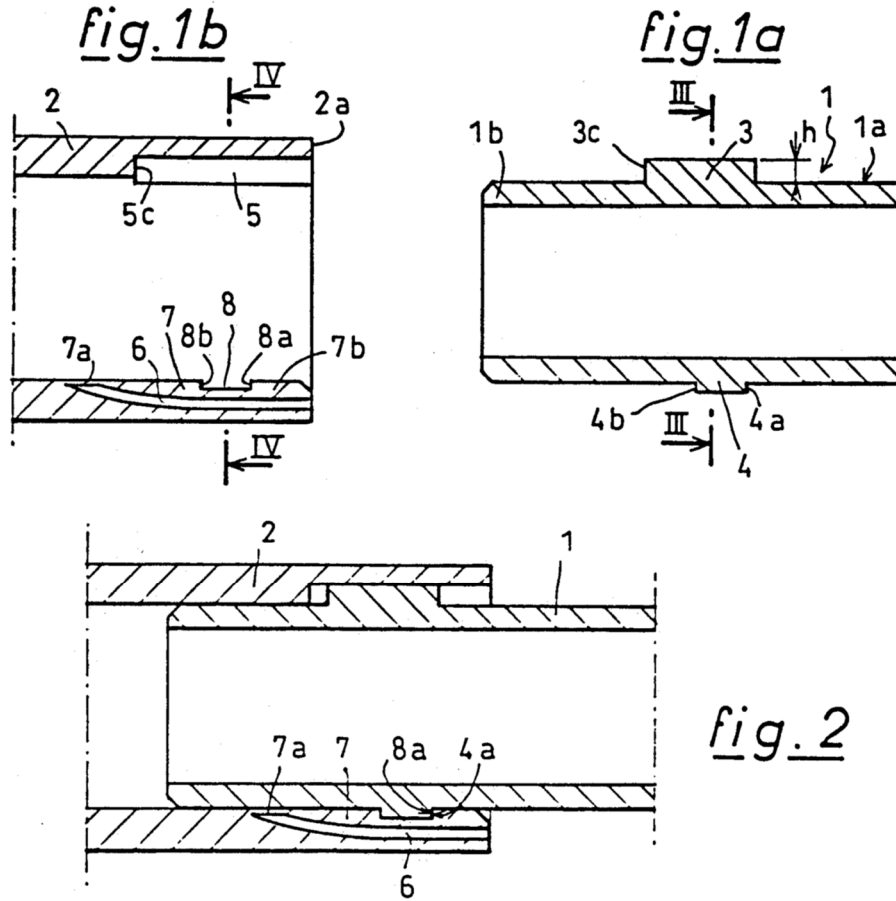


227. Kimber discloses the female fitting being formed as part of a molded portion of an automobile engine, which would have rendered obvious switching the mating protrusion and recess of Guoxin such that the extended portion of Guoxin comprises a female fitting with a recess molded together with the toilet fill valve. The spring arms 48 form an arrangement with apertures 78 in end 24 when inserted.

228. Bjerke and Calmettes each disclose a snap-fit connection between fluid flow channels. This connection is shown in annotated Figures 2 and 4 of Bjerke below.



229. Notably, Ho (EX1022, Figs. 3 and 5) shows a connection similar to that shown in Bjerke. The mating arrangement of the coupling device of Calmettes (EX1018) can be seen with reference to Figures 1a, 1b, and 2, reproduced below.



230. As shown above and explained in Calmettes, the male end of the coupling, denoted by numeral 1, includes a rib, or boss 3 extending axially on one side, and protuberance 4 extending axially on the opposite side of boss 3. Calmettes (EX1018), 3:20-4:54, Fig. 2. Boss 3 mates with groove 5 formed in the interior wall of the female end of the coupling, denoted by numeral 2. *Id.*, 4:22-28. Similarly, protuberance 4 mates with groove 8 to form a snap-fit connection. *Id.*, 4:32-51. Guoxin and Ho, in view of either Kimber, Bjerke, or Calmettes renders obvious claim 5.

2. Claim 7

231. Dependent claim 7 recites “[t]he system of claim 1, wherein the bowl fill restriction further comprises a nipple that is configured to insert into the tube.” ’105 patent, claim 7.

232. Dependent claim 7 recites the bowl fill restriction comprising a nipple. As described and shown above with respect to claims 4 and 5, Ho and Bjerke each discloses a connection between fluid flow channels in which one end comprises a nipple with annular ridges that is inserted into a tube that directs water from the water flow regulator to the toilet tank overflow tube. As such, Guoxin in view of Ho and Bjerke therefore renders obvious claim 7.

3. Claims 16-19

233. Dependent claim 16 recites “[t]he method of claim 15, further comprising preventing the bowl fill restriction from detaching from the extended portion of the body.” ’105 patent, claim 16.

234. Dependent claim 17 recites “[t]he method of claim 16, wherein preventing the bowl fill restriction from detaching from the extended portion further comprises clamping the bowl fill restriction to the extended portion.” ’105 patent, claim 17.

235. Dependent claim 18 recites “[t]he method of claim 16, wherein preventing the bowl fill restriction from detaching from the extended portion further

comprises snapping the bowl fill restriction to the extended portion.” ’105 patent, claim 18.

236. Dependent claim **19** recites “[t]he method of claim 16, wherein preventing the bowl fill restriction from detaching from the extended portion further comprises rotating the bowl fill restriction with respect to the extended portion.” ’105 patent, claim 19.

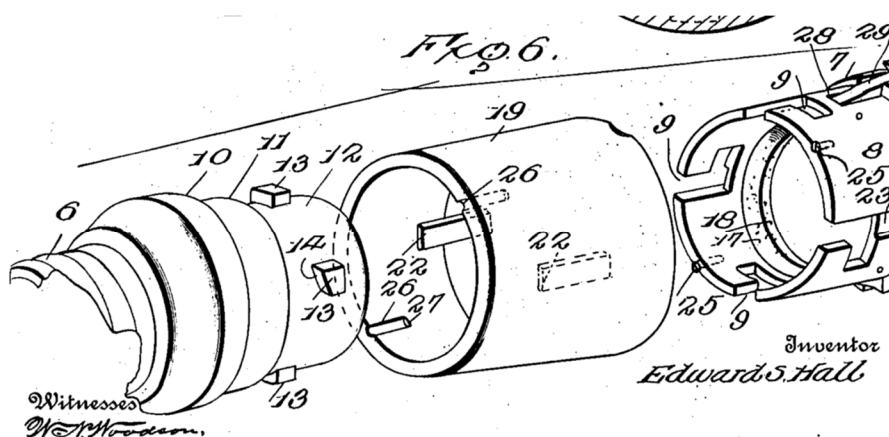
237. Dependent claims 16-19 recite various mechanisms for preventing the bowl fill restriction from detaching from the extended portion of the body. I assume for the sake of this analysis that “preventing” in the context of these dependent claims is not a permanent prevention, but rather only prevents detachment during normal operation of the toilet fill valve.

238. As discussed above with respect to **1[D2]**, Guoxin discloses a protrusion that is configured to insert into and lock within a recess in inlet 401 of the bowl fill restriction, Guoxin (EX1016), Figs. 3-4. Similarly, Ho discloses a protrusion configured to snap fit into a recess in the extended portion of the toilet fill valve. *See* Ho (EX1022), Figs. 3 and 5 below. As such, Guoxin and Ho each disclose the elements of claim 16.

239. Further, preventing detachment via clamping or snapping the bowl fill restriction would have been an obvious design choice, as described above with reference to claims 4 and 5. As stated therein, Guoxin in view of Kimber renders

obvious the subject matter of claim 17, which recites clamping the bowl fill restriction to the toilet fill valve, and Guoxin in view of Bjerke or Calmettes renders obvious the subject matter of claim 18, which recites a snap-fit connection.

240. Dependent claim 19 would also have been obvious over Guoxin in view of Hall. Figure 6 of Hall (EX1019) below illustrates the fluid flow connection device described therein.



241. This well-known coupling in which axial protrusions 13 (lugs) on the male portion mate with grooves 9 (bayonet slots) formed in the female portion, which upon insertion, can be rotated to lock in place, is the same configuration shown in Figures 6A-6C of the '105 patent. Hall (EX1019), 66-85; '105 patent (EX1001), Figs. 6A-6C. Guoxin and Ho, in view of Hall therefore renders obvious claim 19.

D. Claims 1-3, 6, 8-15, and 20-24 are Obvious Under 35 U.S.C. §103 Over Brown in View of Ho

242. Brown is listed on the face of the '105 patent but was not cited to reject the claims. To the extent Brown does not expressly disclose an element of the Challenged Claims, the element is disclosed by Ho. To the extent that it is argued that Brown does not disclose an extended portion integrally molded with the toilet fill valve that extends outwardly and that contains a recess into which a protrusion from a bowl fill valve or restriction device is inserted, Ho discloses this and this connection in Ho can be used in the system of Brown.

243. Both Brown and Ho are directed to toilet valve systems. *See, e.g.*, Brown (EX1021), 1:2-4 (title “Water Silencing and Saving Means for Ball Cock Valve Assembly in Toilet Flush Tank”); Ho (EX1022), p. 1 (title “Toilet Flushing Device”). The systems of both Brown and Ho utilize and describe bowl fill restrictions (e.g., “set screw 26” in Brown and “diverter valve means 30” in Ho) that attach directly to the toilet fill valve to accurately control the amount of water that flows from the toilet fill valve into the toilet bowl. *See, e.g.*, Brown (EX1021), 1:63-70 (“Another object of the invention is to provide an improved water saving means adapted to be connected to the ball cock valve assembly and overflow pipe...including tubular means having a restricted opening therein for reducing the amount of water flowing through the overflow pipe into the toilet bowl and thereby eliminate waste of such water.”), Figs. 1, 3, 4; Ho (EX1022), 1:6-9 (“This invention

relates to a toilet flushing device, more particularly to a toilet flushing which has a diverter valve unit for directing water from the water supplying pipe to the rim flushing conduit of the toilet bowl.”), Figs. 1-5. Similar to the discussion above in Section VIII.B with respect to Guoxin and Ho, the toilet fill valve connectors at issue here are likewise interchangeable.

244. Furthermore, it would be obvious to a POSITA that different known fluid flow connector designs could be simply substituted for one another to obtain predictable results. Indeed, the ’105 patent also contemplates the use of any of a variety of well-known connector configurations: “Also, other snap fit and sealing configurations may be employed beyond those specifically described herein.” The ’105 patent (EX1001), 9:52-53.

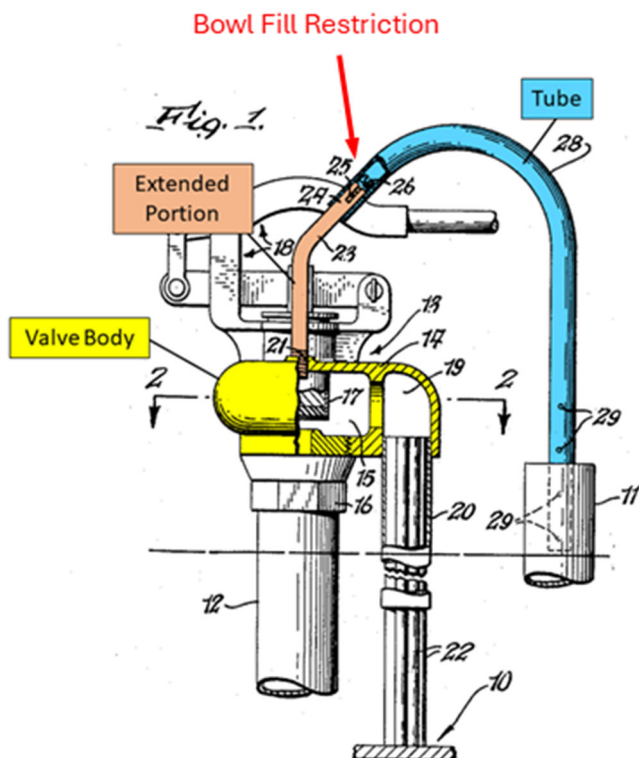
245. In view of the foregoing, using the bowl fill restriction of Ho instead of the bowl fill restriction shown in Brown, would have been obvious to a POSITA as a matter of design preference. They are substitute structures for performing the same function in their known and expected manner and would require only a simple substitution of one known coupling arrangement for another to obtain predictable results.

1. Independent Claims 1 and 24 are Obvious Over Brown in View of Ho

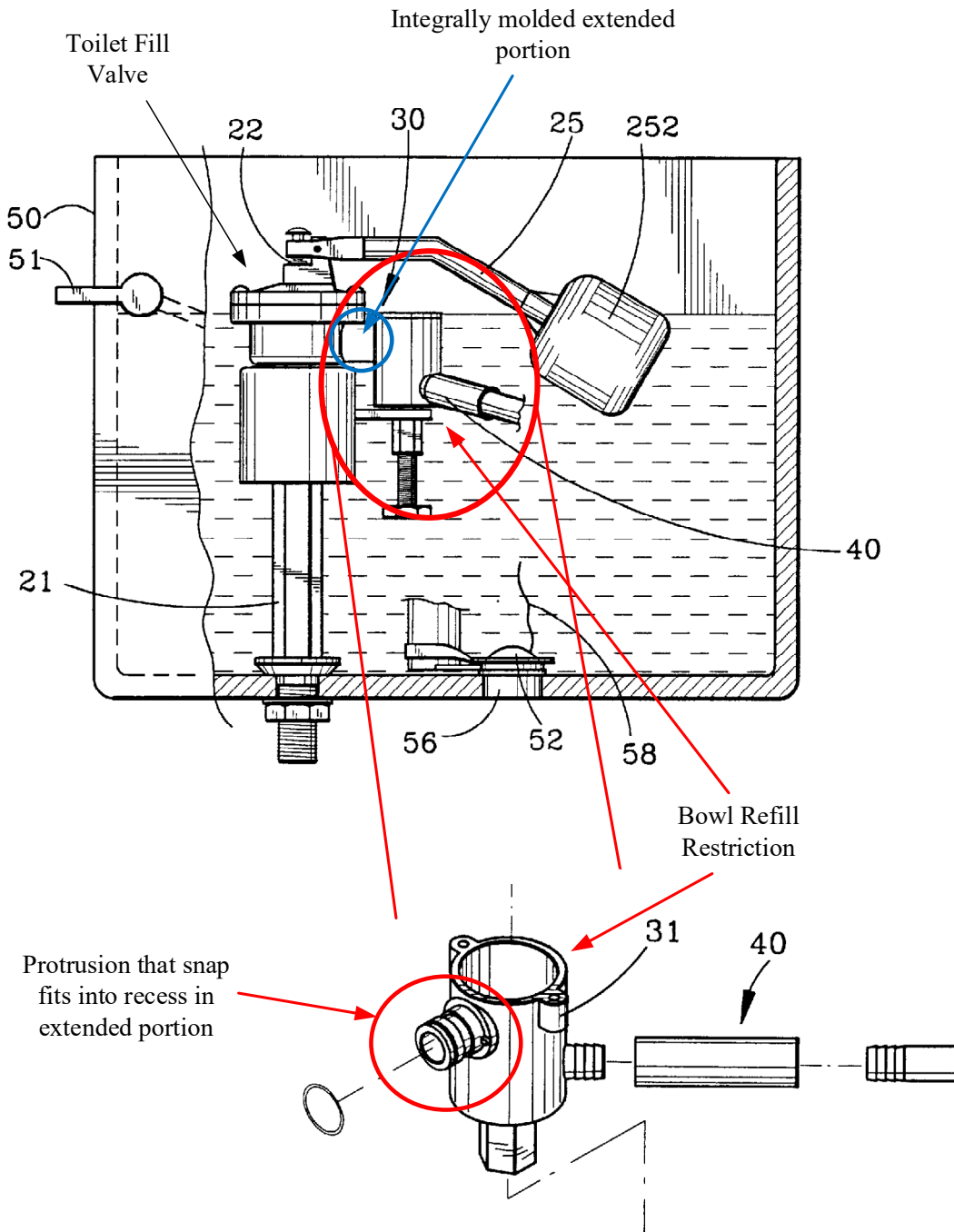
2. Claim Elements 1[Pre], 24 [Pre]

246. Claims 1 and 24 each recite “A system, comprising: a toilet fill valve ...; a bowl fill restriction ...; and a tube ...”

247. Annotated figures of Brown and Ho are provided below that show a system. Brown discloses a system comprising a toilet fill valve that includes at least an upstanding intake pipe 12, an upstanding overflow pipe 11, and a valve assembly mounted on pipe 12 that is referred to in general by number 13 in the annotated figures below. Brown (EX1021), 2:52-57. Brown also has a bowl fill restriction and tube (28).



248. The relevance of Ho to each of the Challenged Claim elements is set forth above in my discussion of the Guoxin and Ho references. *See* annotated Figures 2 and 5 of Ho (EX1022) below for reference:



249. In view of the foregoing, Brown and Ho each satisfy the preamble of claims 1 and 24.

3. Claim Elements 1[A], 24 [A]

250. Claim element **1[A]** recites “a toilet fill valve that comprises: a body comprising an extended portion, wherein the extended portion is integrally molded with the body, wherein the extended portion forms a bowl fill outlet port....” ’105 patent, claim 1.

251. Similarly, claim element **24[A]** recites “a toilet fill valve that comprises: a body comprising an extended portion that forms a bowl fill outlet port, wherein the extended portion is integrally molded with the body” ’105 patent, claim 24.

252. Brown discloses a toilet fill valve with an extended portion 23 that is attached via threaded opening 21. Brown (EX1021), 2:65-67. Extended portion 23, or adapter tube 23 of Brown forms a bowl fill outlet port. Brown’s extended portion 23 is integral to the toilet fill valve once attached via threaded opening 21 in view of the claim constructions proposed here.

253. Alternatively, it would have been obvious to mold the toilet fill valve body of Brown together with the extended portion 23 in a single mold, given the more recently developed molding techniques that were not readily available in 1959 when Brown was filed. Moreover, Ho discloses integrally molded outlets on a toilet

fill valve body that are attached to a bowl fill restriction, thereby rendering obvious integrally molding extended portion 23 with the toilet fill valve body of Brown.

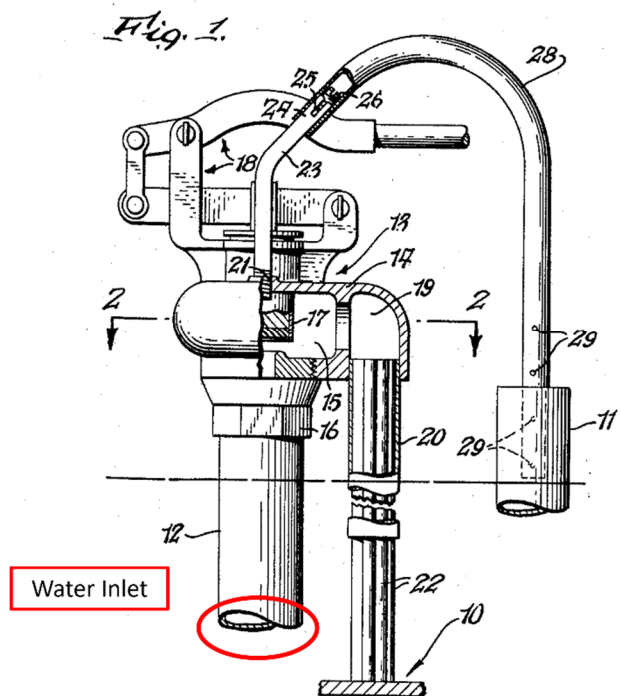
254. Based on Brown alone, or Brown in view of Ho, elements **1[A]** and **24[A]** are obvious

4. Claim Elements 1[B], 24[B]

255. Claim element **1[B]** recites “a water inlet configured to receive water from a water source....” ’105 patent, claim 1.

256. Claim element **24[B]** also recites “a water inlet configured to receive water from a water source” ’105 patent, claim 24.

257. Brown’s upstanding intake pipe 12 (EX1021, 2:54-55, Annotated Fig. 1 below), and Ho’s water supplying pipe 21 (EX1022, Fig. 3), each disclose a water inlet configured to receive water from a water source.



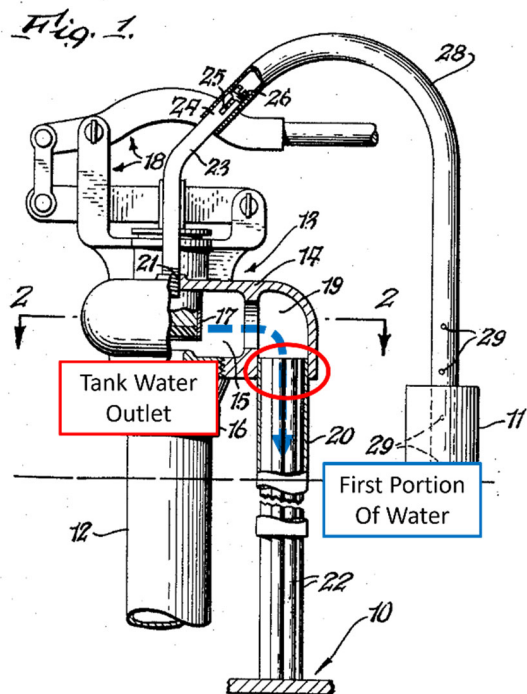
258. In view of the foregoing, Brown and Ho each satisfy these elements.

5. Claim Elements 1[C], 24[C]

259. Claim element 1[C] recites “a tank water outlet configured to provide a first portion of the water to a toilet tank during at least a portion of a flush cycle....” ’105 patent, claim 1.

260. Claim element 24[C] also recites “a tank water outlet configured to provide a first portion of the water to a toilet tank during at least a portion of a flush cycle....” ’105 patent, claim 24.

261. Brown discloses tank water outlet 20 that allows water to flow into tank 10. Brown (EX1021), 3:1-4; Annotated Fig. 1 below. Brown therefore satisfies this element.



6. Claim Elements 1[D1], 24[D1]

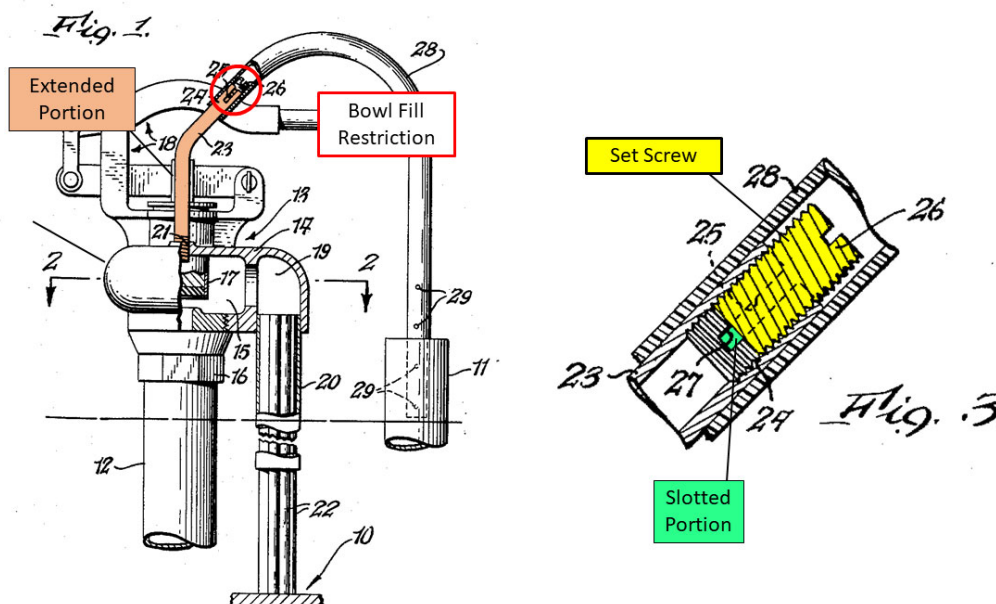
262. Claim element **1[B]** recites “a bowl fill restriction configured to attach directly to the extended portion of the body....” ’105 patent, claim 1.

263. Claim element **24[D1]** also recites “a bowl fill restriction configured to attach directly to the extended portion of the body of the toilet fill valve....” ’105 patent, claim 24.

264. Brown discloses a bowl fill restriction in the form of set screw 26 that attaches to the slotted portion 24 of adapter tube 23, which is attached directly to the main body of adaptor tube 23 (extended portion) of toilet fill valve and where “[t]he slotted portion 24 of adapter tube 23 and the set screw 26 form an adjustable metering valve for confining the flow of water through the restricted opening 27

formed between slots 25 of portion 24 and the end of set screw 26.” Brown (EX1021), 3:52-56, annotated Figs. 1 and 3 below. Brown therefore satisfies this element.

1d.1

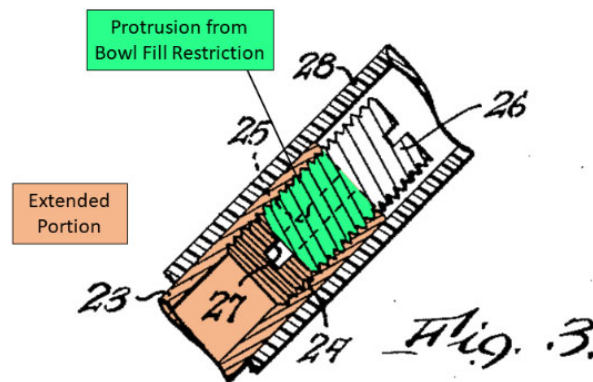


7. Claim Element 1[D2]

265. Claim element 1[D2] recites “wherein the bowl fill restriction comprises a protrusion that is configured to insert into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the body” ’105 patent, claim 1.

266. A portion of set screw 26 of Brown is a protrusion that is configured to insert into a recess in the extended portion (adaptor tube 23) of the toilet fill valve, where the external threads of the screw engage the internal mating threads of the adaptor tube in order to lock the set screw to the extended portion of the body. EX1021, annotated Fig. 3 below. A POSITA would understand that the set screw 26

of Brown is designed such that it is self-locking and does not back-out once set. This is because the set screw is used to adjust the flow through the metering valve and needs to remain locked in place once set in order to perform this function.



267. Brown discloses a protrusion on a bowl fill restriction that locks into a recess in an integrally molded extended portion of the toilet fill valve, thereby satisfies this element.

8. Claim Element 24[D2]

268. Claim element **24[D2]** recites “wherein the bowl fill restriction comprises means for locking the bowl fill restriction to the extended portion of the body of the toilet fill valve....” ’105 patent, claim 24.

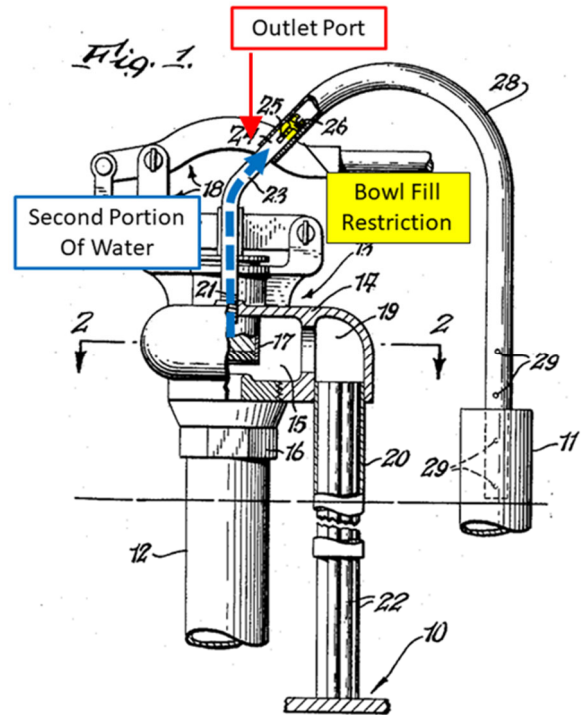
269. As described above with reference to claim element **1[D2]**, Brown discloses means for locking the bowl fill restriction to the extended portion. Brown therefore satisfies this element.

9. Claim Elements 1[D3], 24[D3]

270. Claim element 1[D3] recites “wherein the bowl fill restriction is configured to receive a second portion of the water from the bowl fill outlet port during at least a portion of the flush cycle....” ’105 patent, claim 1.

271. Claim element 24[D3] also recites “wherein the bowl fill restriction is configured to receive a second portion of the water from the bowl fill outlet port during at least a portion of the flush cycle....” ’105 patent, claim 24.

272. Brown discloses water being supplied from pipe 12 into main chamber 15 and then divided into two paths. The major portion flows downwardly into tank through fill tube, and the remainder, or second portion, flows through opening 21 through extended portion 23, bowl fill restriction 26, and eventually to overflow pipe 11. Brown (EX1021), 2:72–3:6, *see* annotated Figure 1 below.



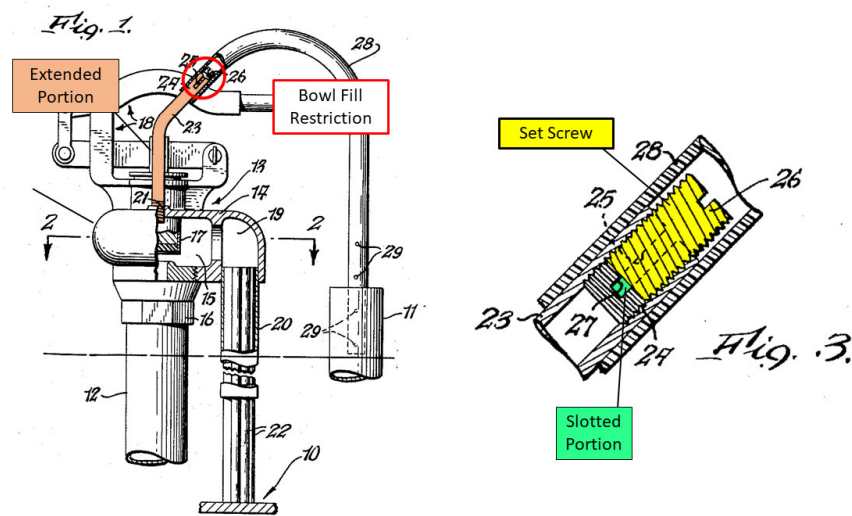
273. Ho's disclosure of this element is discussed above with respect to the combination of the Guoxin and Ho references. In view of the foregoing, Brown and Ho therefore each satisfy this element.

10. Claim Elements 1[D4], 24[D4]

274. Claim element 1[D4] recites "wherein the restriction is configured to constrict a flow rate of the second portion of the water that flows through the bowl fill restriction...." '105 patent, claim 1.

275. Claim element 24[D4] also recites "wherein the restriction is configured to constrict a flow rate of the second portion of the water that flows through the bowl fill restriction...." '105 patent, claim 24.

276. Brown discloses a bowl fill restriction that is configured to constrict a flow rate of the second portion: “The slotted portion 24 of adapter tube 23 and the set screw 26 form an adjustable metering valve for confining the flow of water through the restricted opening 27....” Brown (EX1021), 3:52-56, Figs. 1 and 3; annotated Fig. 3 below. Brown therefore satisfies this element.



11. Claim Elements 1[E], 24[E]

277. Claim element 1[E] recites “a tube that is configured to attach directly to the bowl fill restriction, wherein the tube is configured to direct the second portion of the water from the bowl fill restriction directly to a toilet tank overflow tube.” ’105 patent, claim 1.

278. Claim element 24[E] also recites “a tube configured to attach directly to the bowl fill restriction, wherein the tube is configured to direct the second portion

of the water from the bowl fill restriction to a toilet tank overflow tube.” ’105 patent, claim 24.

279. Brown discloses a tube 28 attached directly to the portion of adaptor tube 23 that forms the metering valve and houses set screw 26. Tube 28 directs the second portion of water to a toilet tank overflow tube, as is conventional in the art, from the bowl fill restriction (metering valve). *See* claim elements **1[Pre]** and **24[Pre]** above. Ho discloses a diverter valve 30 (bowl fill restriction) with a supply line 40 (tube) attached directly to the valve in order to direct a portion of water from the valve to the toilet tank overflow tube. *See* Ho (EX1022), 3:6-11, Fig. 2. To the extent it is argued that Brown does not disclose this limitation, a POSITA would understand that the valve disclosed in Ho, with a tube directly attached to the valve in order to direct water to the overflow pipe, could be adapted for use with the system disclosed in Brown. A POSITA would understand that the valve disclosed in Ho accomplishes the same flow control function as the Brown valve but has an advantage over the Brown valve in that the adjustment of the flow of water through the Ho valve can be accomplished with the tube still connected to the valve. In contrast, the Brown valve requires the tube to first be disconnected so that the set screw can be used to adjust the flow through the valve. A POSITA would thus be motivated to use the Ho valve, with its ability to be adjusted without disconnecting the valve and its direct connection to the tube supplying the overflow pipe, in order to simplify the operation

of the valve and increase the ease with which the valve can be adjusted. Thus, Brown or Brown in view of Ho renders this element obvious.

12. Summary of Opinions Regarding Independent Claims 1 and 24

280. Independent Claims 1 and 24 are obvious over Brown or Brown in view of Ho. To the extent that it is argued that Brown does not expressly disclose integrally molded extended portion of the toilet fill valve body, it would have been obvious to form extended portion 23 of Brown as an integrally molded extension, as disclosed by Ho. A POSITA would have found it obvious to modify Brown's toilet fill valve, disclosed in 1959 when polymers were first discovered, by using more modern molding technology as illustrated in Ho. However, Brown discloses this element given the '105 patent's definition of "integral" would include the extended portion 23 of Brown screwed onto threaded opening 21. Similarly, to the extent it is argued that a tube that is configured to attach directly to the bowl fill restriction is not present in Brown, the system of Brown using the bowl fill restriction of Ho connected as shown in Ho discloses all of the limitations. In view of the foregoing, Brown alone, or Brown in view of Ho renders obvious all of the elements recited by independent claims 1 and 24 of the '105 patent.

13. Independent Claim 9 is Obvious Over Brown in View of Ho

281. Independent claim 9 is obvious over Brown in view of Ho for the generally the same reasons as claims 1 and 24 are obvious as described above. Claim

9 is fundamentally nothing more than the method (steps) performed when using the system of claims 1 and 24.

14. Claim Elements 9[Pre], 9[A]

282. Claim elements 9[Pre] and 9[A] recite, respectively, “[a] method, comprising” and “receiving, via a water inlet of a toilet fill valve, water from a water supply.” ’105 patent, claim 9.

283. Brown discloses permitting “supply water to flow from pipe 12 into main chamber 15.” Brown (EX1021), 2:72–3:1; *see* Ho discussed above. Thus, Brown and Ho each satisfy the preamble and this element.

15. Claim Element 9[B]

284. Claim element 9[B] recites “providing, via a tank water outlet of the toilet fill valve, a first portion of the water to a toilet tank...” ’105 patent, claim 9.

285. Brown discloses “The major portion of water flows into auxiliary chamber 19, reversing direction and flowing downwardly into tank 10 through fill tube 20.” Brown (EX1021), 3:1-4. Brown therefore satisfies this element.

16. Claim Element 9[C1]

286. Claim element 1[C1] recites “providing, via a bowl fill outlet port of the toilet fill valve, a second portion of the water to a bowl fill restriction, wherein an extended portion of the toilet fill valve forms the bowl fill outlet port...” ’105 patent, claim 1.

287. As discussed above with respect to **1[D3]** and **24[D3]**, Brown discloses water being supplied from pipe 12 into main chamber 15 and divided into two paths. The major portion flows downwardly into tank through a fill tube, and the remainder, or second portion, flows through opening 21 through extended portion 23 (of the toilet fill valve), bowl fill restriction 26, and eventually to overflow pipe 11. Brown (EX1021), 2:72–3:6, Fig. 1. Brown therefore satisfies this element.

17. Claim Element 9[C2]

288. Claim element **9[C2]** recites “wherein the extended portion is integrally molded with the toilet fill valve...” ’105 patent, claim 9.

289. As discussed above with respect to **1[A]** and **24[A]**, both Brown and Ho disclose and illustrate radially extending extended portions integrally molded with the toilet valve body. Thus, Brown alone or in view of Ho, renders this element obvious.

18. Claim Element 9[C3]

290. Claim element **9[C3]** recites “wherein the bowl fill restriction is in direct contact with the extended portion of the toilet fill valve...” ’105 patent, claim 9.

291. Brown discloses a bowl fill restriction in the form of set screw 26 and slotted portion 24 of adapter tube 23, which is attached directly to the main body of

adaptor tube 23 (the extended portion) of toilet fill valve. Brown (EX1021), 3:52-56, Figs. 1 and 3. Brown alone or in view of Ho therefore satisfies this element.

19. Claim Element 9[C4]

292. Claim element **9[C4]** recites “wherein the bowl fill restriction is constructed as a single piece....” ’105 patent, claim 9.

293. This claim element does not further limit the method of claim 9. The figures of Brown and Ho show Brown’s set screw 26 and slotted portion 24 and Ho’s diverter valve 30 as unitary structures. This is similar to the valve shown in the embodiments of the ’105 patent that have a movable handle. Indeed, providing a bowl fill restriction as a single piece, as disclosed by Brown, and illustrated in the figures of Ho, would be advantageous in that assembly of the bowl fill restriction and toilet fill valve would simply require snapping, screwing, or pressing the two pieces together. This element is disclosed by the prior art, is obvious in view of the prior art, and it is not an element that provides any meaningful limitation to method claim 9.

20. Claim Element 9[C5]

294. Claim element **9[C5]** recites “wherein the bowl fill restriction causes a flow of the second portion of the water to be constricted....” ’105 patent, claim 9.

295. Brown and Ho satisfy this element for the same reasons discussed with respect to **1[D4]** and **24[D4]** above.

21. Claim Element 9[D]

296. Claim element **9[D]** recites “providing, via the bowl fill restriction, the second portion of the water to a tube that is in direct contact with the bowl fill restriction; and providing, via the tube, the second portion of the water to a toilet tank overflow tube.” ’105 patent, claim 9.

297. Brown and Ho satisfy this element for the same reasons discussed above regarding **1[E]** and **24[E]**.

22. Summary of Opinions Regarding Independent Claim 9

298. In sum, Brown and Ho individually or in combination disclose or render obvious all of the elements recited by independent claim 9.

23. Independent Claim 15 is Obvious Over Brown in View of Ho

299. Independent claim 15 is obvious over Guoxin in view of Ho for the generally the same reasons as claims 1 and 24 are obvious as described above. Claim 15 is fundamentally nothing more than the method (steps) performed when assembling the system of claims 1 and 24. For the same reasons discussed above with respect to Guoxin and Ho, fabricating various parts separately and designing the separate parts for easy assembly would have been considered obvious design parameters and/or obvious and routine optimization to a POSITA prior to the ’105 patent filing date. There is nothing unique, unexpected, or unobvious in the method steps recited by claims 9 and 15.

24. Claim Element 15[Pre]

300. Claim element **15[Pre]** recites “[a] method, comprising....” ’105 patent, claim 15.

301. To the extent any of the respective pieces of the toilet fill valve and bowl fill restrictions disclosed by Brown and Ho are assembled prior to operation of the toilet fill valve, the cited art inherently discloses a method of assembling the respective parts.

25. Claim Element 15[A1]

302. Claim element **15[A1]** recites “attaching a bowl fill restriction directly to an extended portion of a body of a toilet fill valve, wherein the extended portion is integrally molded with the body....” ’105 patent, claim 15.

303. Brown alone or in view of Ho discloses or renders obvious this element for the same reasons discussed above with respect to **1[A]**, **24[A]** **1[D1]**, **24[D1]**, **9[C2]**, and **9[C3]**.

26. Claim Element 15[A2]

304. Claim element **15[Pre]** recites “wherein the extended portion forms a bowl fill outlet port, wherein the bowl fill restriction is configured to constrict a flow rate of water that flows out of the bowl fill outlet port” ’105 patent, claim 15.

305. As discussed above with respect to **1[A]**, **24[A]**, **1[D4]**, **24[D4]**, and **9[C5]**, this claim element does not further limit this method claim, and prior art that

restricts or diverts fluid flow will inherently satisfy this element. For the same reasons discussed therein, Brown and Ho disclose or render obvious this element.

27. Claim Element 15[B]

306. Claim element **15[B]** recites “inserting a protrusion of the bowl fill restriction into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the body....” ’105 patent, claim 15.

307. A portion of set screw 26 of Brown is a protrusion that is configured to insert into a recess in the extended portion 23 of the toilet fill valve, and its threads form ridges or protrusions that lock with mating threads on slotted portion 24 of extended portion 23. *See* Brown (EX1021), Fig. 3; *see* discussion of claim elements **1[D2]** and **15[B]** above. Additionally, Ho discloses a protrusion configured to snap fit into a recess in the extended portion of the toilet fill valve. *See* Ho (EX1022), annotated Figs. 3 and 5 above with respect to the combination of Guoxin and Ho. Brown and Ho therefore satisfy this element.

28. Claim Element 15[C]

308. Claim element **15[C]** recites “attaching a tube directly to the bowl fill restriction, wherein the tube is configured to direct the water from the bowl fill restriction directly to a toilet tank overflow tube.” ’105 patent, claim 15.

309. Directing a second portion of water to a toilet tank overflow tube is conventional in the art and disclosed by Brown. *See* discussion of **1[Pre]** and **24[Pre]**

above.. Brown discloses tube 28, and therefore satisfies this element either alone or in combination with Ho. *See* 1[E], 24[E], and 9[D] above.

29. Summary of Opinions Regarding Independent Claim 15

310. In sum, Brown and Ho individually or in combination disclose or render obvious all of the elements recited by independent claim 15.

30. Dependent Claims 2-3, 6, 8, 10-14, and 16-23 are Obvious Over Brown in view of Ho

a) Claim 2

311. Dependent claim 2 recites “[t]he system of claim 1, wherein the extended portion of the body extends radially from a longitudinal axis of the toilet fill valve.” ’105 patent, claim 2.

312. To the extent that Brown does not disclose its extended portion 23 extending radially, that feature is disclosed clearly by Ho. Ho (EX1022), Figs. 3 and 6-11. Moreover, when integrally molding the toilet fill valve with the extended portion, as would have been obvious for the reasons stated above, a POSITA would have readily molded the extended portion to extend radially from the longitudinal axis of the toilet fill valve to more readily facilitate the connection with the bowl fill restriction. Furthermore, such an arrangement (i.e., where the extended portion extends radially) allows for flexibility in order to create a more compact toilet fill valve system that could be adapted to fit in more toilet tank designs. Thus, Brown in view of Ho renders obvious claim 2.

b) Claim 3

313. Dependent claim 3 recites “[t]he system of claim 1, wherein a portion of the bowl fill restriction is configured to insert into the extended portion of the body.” ’105 patent, claim 3.

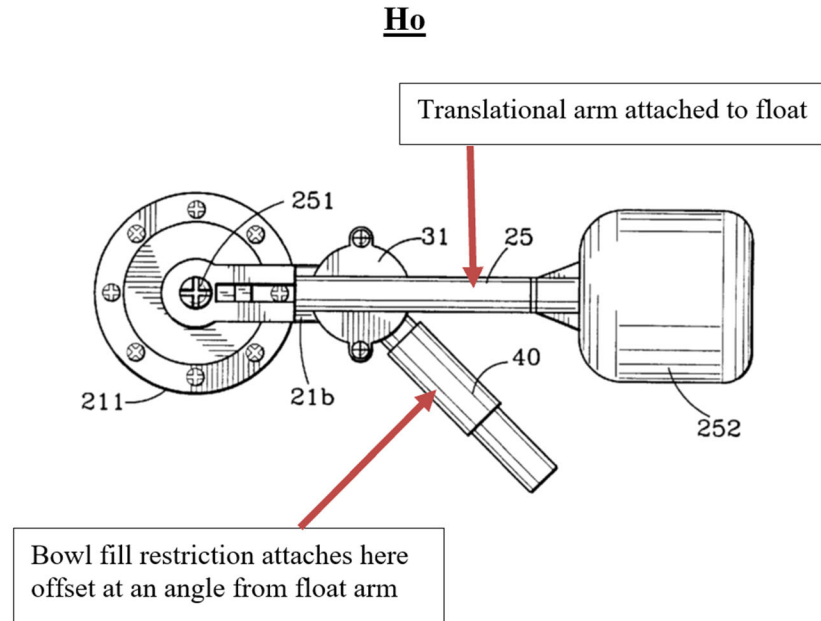
314. Brown discloses the features of claim 3 by virtue of inserting a portion of screw 26 into extended portion 23. Brown (EX1021), 3:45-51, Figs. 1 and 3. Ho likewise discloses this feature by inserting the nipple into the recess in the extended portion, as shown in Figure 5 (EX1022). Thus, Brown and Ho disclose the features of claim 3.

c) Claim 6

315. Claim 6 recites “[t]he system of claim 1, wherein the toilet fill valve further comprises: a float; and an actuating arm coupled to the float, wherein the actuating arm extends radially relative to a longitudinal axis of the toilet fill valve, wherein the actuating arm is angularly offset relative to the bowl fill valve, thereby preventing an interference with the bowl fill restriction and a translational stem that extends from the float to a free end of the actuating arm.” ’105 patent, claim 6.

316. The features recited by claim 6 are disclosed and illustrated in each of Brown and Ho, and would have been intuitively obvious to a POSITA. It would make little sense to design a toilet fill valve with a conventional float attached to a translational arm that was obstructed in some manner from freely translating—as is

clearly shown in Ho. *See* Brown (EX1021), Fig. 2; Ho (EX1022), Fig. 6 below. Thus, Brown and Ho disclose the features of claim 6, thereby rendering it obvious.



d) Claim 8

317. Claim 8 recites “[t]he system of claim 1, wherein the bowl fill restriction being attached directly to the extended portion of the body prevents a pressure head from being formed in the tube.” ’105 patent, claim 8.

318. Dependent claim 8, to the extent it recites a limitation to the fill valve of claim 1, merely recites the inherent feature and function of preventing a pressure head formed in the outlet tube from the bowl fill restriction due to the direct connection between the bowl fill restriction of Brown or Ho, and the extended portion of the toilet fill valve. When the bowl fill restriction is attached to the extended portion of the toilet fill valve, rather than within the tube directing water

to the overflow tube, the pressure head forms within the extended portion instead of within the tube itself. Brown and Ho each inherently discloses the elements of claim 8 by virtue of the direct connection between the bowl fill restriction and the extended portion of the toilet fill valve.

e) Claim 10

319. Claim **10** recites “[t]he method of claim 9, wherein the bowl fill restriction being in direct contact with the extended portion of the toilet fill valve prevents a pressure head from being formed in the tube.” ’105 patent, claim 10.

320. For the same reasons discussed above with respect to claim 8, Brown and Ho disclose a direct connection between the bowl fill restriction and the extended portion of the toilet fill valve, which thereby inherently prevents a pressure head from being formed in the tube. Thus, claim 10 is obvious over Brown and Ho.

f) Claims 11 and 12

321. Claim **11** recites “[t]he method of claim 9, further comprising terminating, using the toilet fill valve, the flow of the second portion of the water so that a water level in a toilet bowl is at a predefined level.” ’105 patent, claim 11.

322. Claim **12** recites “[t]he method of claim 11, wherein the water level is determined at least in part by the bowl fill restriction.” ’105 patent, claim 12.

323. Brown discloses using the set screw to ensure the second flow of water to the toilet bowl is at a predetermined level when the toilet fill valve closes the water

supply. Brown (EX1021), 3:45-71. If not expressly disclosed, it is very well-known in the art that conventional ball cock valves used in toilet fill valve, such as reciprocating valve 17 in chamber 15 of Brown's ball cock valve assembly 13, open when the float is lowered, and closes to terminate the water flow when the float rises to the tank refill level. Brown (EX1021), 2:52-71, Fig. 1. Dependent claims 11 and 12 are therefore obvious over Brown alone, or further in view of Ho.

g) Claims 13 and 14

324. Dependent claim **13** recites "[t]he method of claim 9, wherein the extended portion of the toilet fill valve is a portion of a body of the toilet fill valve." '105 patent, claim 13.

325. Dependent claim **14** recites "[t]he method of claim 9, wherein the extended portion of the toilet fill valve extends radially from a longitudinal axis of the toilet fill valve." '105 patent, claim 14.

326. Dependent claims 13 and 14 are obvious over Brown alone or Brown in view of Ho for the same reasons discussed above with respect to elements **1[A]**, **24[A]**, **15[A1]** and dependent claim 2.

h) Claim 20

327. Dependent claim **20** recites "[t]he method of claim 15, wherein attaching a bowl fill restriction directly to the extended portion of the body of the

toilet fill valve further comprises inserting a portion of the bowl fill restriction into the extended portion of the body.” ’105 patent, claim 20.

328. For the same reasons discussed above with respect to claim 3, Brown in view Ho renders obvious claim 20.

i) Claims 21 and 23

329. Dependent claim **21** recites “[t]he system of claim 1, wherein the bowl fill restriction is constructed of a single piece.” ’105 patent, claim 21.

330. Dependent claim **23** recites “[t]he method of claim 15, wherein the bowl fill restriction is constructed of a single piece.” ’105 patent, claim 23.

331. Dependent claims 21 and 23 are either disclosed by Brown and Ho or are obvious over Brown and Ho for the same reasons as discussed with respect to element **9[C4]**. Indeed, having the bowl fill restriction as a unitary structure, as disclosed by Brown, and illustrated in the Figures of Ho, would be advantageous in that in that assembly of the bowl fill restriction and toilet fill valve would simply require snapping or pressing the two pieces together.

j) Claim 22

332. Dependent claim **22** recites “[t]he method of claim 9, wherein the bowl fill restriction comprises a protrusion that is configured to insert into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the toilet fill valve.” ’105 patent, claim 22.

333. For the same reasons discussed above with respect to elements **1[D2]** and **24[D2]**, Brown discloses the elements of claim 22 or would have rendered the claim obvious.

E. Dependent Claims 4, 5, 7, and 16-19 are Obvious Under 35 U.S.C. §103 Over Brown in view of Ho, and Further in View of the Quick Connection Art

334. The connection between the two fluid channels recited by dependent claims 4, 5, 7, and 16-19 are well-known fluid flow connections disclosed by numerous documents such as Bjerke, Calmettes, Hall, and Kimber—the Quick Connection Art.

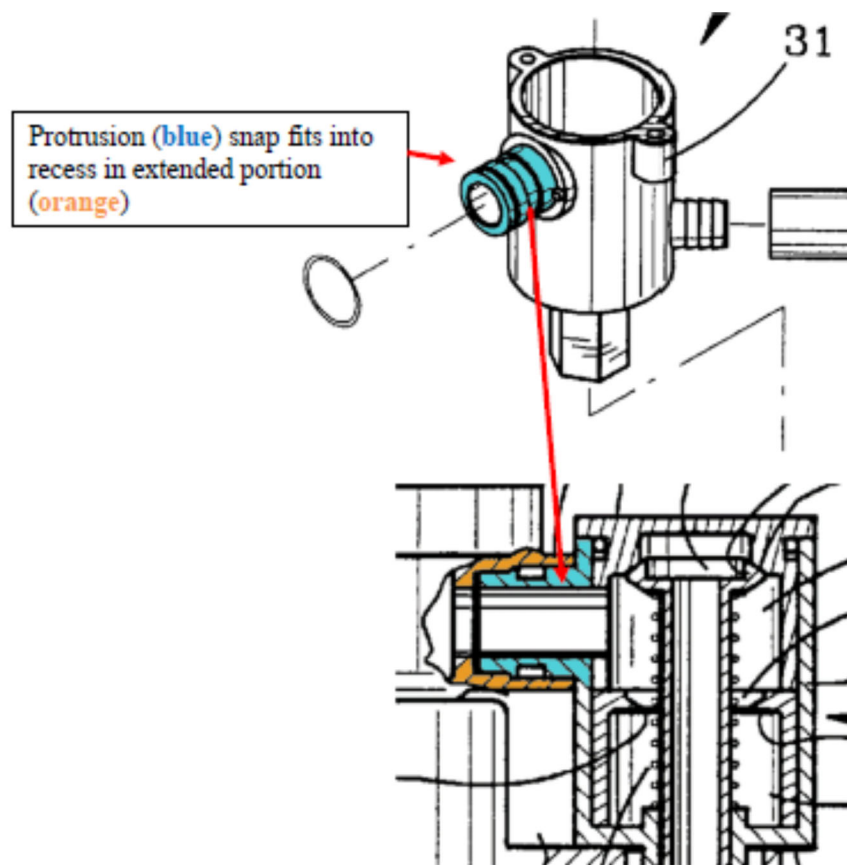
335. To the extent Brown in view of Ho does not expressly disclose these mechanisms of attachment, it would have been obvious to a POSITA to use any known method of connecting two fluid channels to one another, such as any of those disclosed in the Quick Connection Art, for the same reasons discussed above with respect to Guoxin and Ho.

1. Claim 4

336. Dependent claim 4 recites “[t]he system of claim 1, wherein the bowl fill restriction is configured to be clamped to the extended portion of the body.” ’105 patent, claim 4.

337. Brown discloses a set screw that engages the extend portion of the toilet fill valve through its threads. Ho discloses an integrally molded extended portion on

a toilet fill valve with a recess into which a bowl fill restriction device with a protrusion is inserted and locked into place. *See* Ho (EX1022), annotated Figs. 3 and 5 below. Ho's bowl fill restriction is inserted within extended portion such that a compressive force is created between the internal surface of extended portion and the external surface of the bowl fill restriction in order to maintain a tight connection. Such a connection is similar to that of Horad, Shaw, and Williams, all of which rely upon compressive force (i.e., clamping) in order to create the friction necessary to maintain connections with the bowl fill restriction.

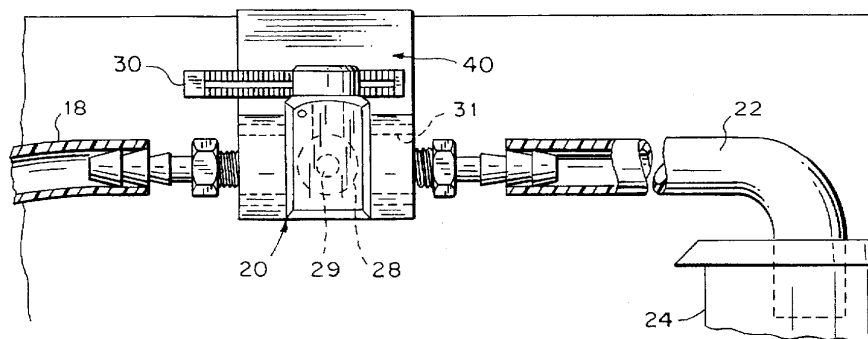


338. To the extent Bown in view of Ho does not expressly disclose a bowl fill restriction that is configured to be clamped to the extended portion of the body,

it would have been obvious to a POSITA to use any known method of connecting two fluid channels to one another, such as any of those disclosed in the Quick Connection Art. The '105 patent does not define the term “clamping” and uses the term clamping only once with reference to the fluid flow connection between the toilet and bowl fill valves. '105 patent (EX1001), 2:23-26. Rather, the '105 patent uses the term “clamping” as generally referring to the use of compressive force. *Id.*, 8:20-26 (“The clamping or compression of the sealing ring 276 pushes the locking ears 266 into the locking position 279 of the locking grooves 269 once the bowl fill valve 203 is rotated accordingly. In this respect, the compressive force of the sealing ring 276 helps keep the bowl fill valve inlet port 213.b of the bowl fill valve 203 mated with the bowl fill outlet port 206b.”). Further, the '105 patent places no criticality on the particular connection mechanism employed: “...other snap fit and sealing configurations may be employed beyond those specifically described herein.” *Id.*, 9:52-53.

339. For example, Horad (EX1025) shows a bowl fill valve (20) connected in-line with the bowl fill tube (22), to adjustably control the flow of water to the overflow tube (24) and into the bowl. *See* EX1025, 2:5-46, Figs. 1-2. As shown in Figure 2 below, valve 20 is friction fit into tube 18 and tube 22. Such a connection necessarily relies upon compressive force, i.e. clamping, in order to maintain the connection.

FIG. 2



340. Similarly, the flow control inserts 104 and 105 of Shaw (EX1026) “are retained in bowl fill tube assembly 106, when used, by frictional contact between their outer surface and the inner surface of the tube in which they are inserted.” *See* EX1026, 8:17-20. Such a connection necessarily relies upon compressive force, i.e. clamping, in order to maintain the friction force connection. *See also*, Williams (EX1027), 3:8-17, Fig. 1.

341. Thus, Brown in view of Ho and further in view of the knowledge of a POSITA would therefore render claim 4 obvious.

2. Claim 5

342. Dependent claim 5 recites “[t]he system of claim 1, wherein the bowl fill restriction is configured to be snapped onto the extended portion of the body.” ’105 patent, claim 5.

343. As discussed above in Paragraphs 218-230, Bjerke and Calmettes each disclose a snap-fit connection between fluid flow channels. It would have been

obvious to substitute the known fluid channel connections taught by any one of Kimber, Bjerke, and Calmettes for the fluid channel connections disclosed by Brown and Ho, and reasonably expect the fluid flow connections would serve their known and expected purpose and function. Thus, Brown and Ho, in view of either Bjerke or Calmettes renders obvious claim 5.

3. Claim 7

344. Dependent claim 7 recites “[t]he system of claim 1, wherein the bowl fill restriction further comprises a nipple that is configured to insert into the tube.” ’105 patent, claim 7.

345. As discussed above with respect to claims 4 and 5, Ho and Bjerke each discloses a connection between fluid flow channels in which one end comprises a nipple with annular ridges that is inserted into a tube that directs water from the water flow regulator to the toilet tank overflow tube. Brown in view of Bjerke and Ho therefore renders obvious dependent claim 7.

4. Claims 16-19

346. Dependent claim 16 recites “[t]he method of claim 15, further comprising preventing the bowl fill restriction from detaching from the extended portion of the body.” ’105 patent, claim 16.

347. Dependent claim 17 recites “[t]he method of claim 16, wherein preventing the bowl fill restriction from detaching from the extended portion further

comprises clamping the bowl fill restriction to the extended portion.” ’105 patent, claim 17.

348. Dependent claim **18** recites “[t]he method of claim 16, wherein preventing the bowl fill restriction from detaching from the extended portion further comprises snapping the bowl fill restriction to the extended portion.” ’105 patent, claim 18.

349. Dependent claim **19** recites “[t]he method of claim 16, wherein preventing the bowl fill restriction from detaching from the extended portion further comprises rotating the bowl fill restriction with respect to the extended portion.” ’105 patent, claim 19.

350. Dependent claims 16-19 recite various mechanisms for preventing the bowl fill restriction from detaching from the extended portion of the body. I again assume for the sake of this analysis that “preventing” in the context of these dependent claims is not a permanent prevention, but rather only prevents detachment during normal operation of the toilet fill valve.

351. Brown discloses preventing detachment by use of a set screw 26, which is inserted into a recess in extended portion 23, and turned or rotated to adjust the amount of water flowing therethrough, thereby satisfying the elements recited by dependent claims 16 and 19. Brown (EX1021), 3:45-71.

352. Preventing detachment via clamping or snapping the bowl fill restriction would have been an obvious design choice, as described above with reference to claims 4 and 5, and for the reasons discussed above in Paragraphs 92, 218, 222-227, 233-241. For the same reasons, Brown in view of Kimber renders obvious the subject matter of claim 17, and Brown in view of Bjerke or Calmettes renders obvious the subject matter of dependent claim 18, which recites a snap-fit connection.

353. Dependent claim 19 would also have been obvious over Brown in view of Hall. Hall, discussed in Paragraphs 91, 218, 233-241. above, discloses a well-known coupling, which upon insertion, can be rotated to lock in place. This is the same configuration shown in Figures 6A-6C of the '105 patent. Thus, Brown and Ho, in view of Hall therefore renders dependent claim 19 obvious.

F. Claims 1-24 Are Anticipated By Schuster

354. Schuster (EX1029) was published on January 31, 2012, more than a year prior to the '105 patent claims' effective filing date of January 27, 2014. With the exception of the title, Abstract, and claims, Schuster and the '105 patent specifications appear to be identical.

355. My analysis here is premised on the Challenged Claims having a priority date of January 27, 2014, the first time the Abstract and claims included the expression "bowl fill restriction." The earlier filed applications in the '105 patent

family do not provide written description support for the Challenged Claims, and as a consequence, Schuster is available as prior art under 35 U.S.C. §102(a)(1).

1. Patent Owner Will Not Be Able to Meet Its Burden of Production to Show Entitlement to Its Priority Applications

356. I understand that Patent Owner has the burden of production to show that each claim has section 112(a) support in the application to which PO claims priority. I further understand that this burden-shifting law applies even when the applications from which the patent issued are designated “continuation” applications and in Patent Office proceedings.

357. I understand that for a claim to be entitled to the ‘the filing date of an earlier application under 35 U.S.C. §120, each application in the chain leading back to the earlier application must comply with the written description requirement of 35 U.S.C. §112. I also understand that failure to show written description support in an ancestor application can result in claims being found unpatentable based on intervening prior art. I further understand that it is not enough that the claims would have been obvious in view of the ancestor application’s disclosure.

358. I further understand that where an applicant files a first application describing an invention in narrow terms, and later files an application recasting the invention in broader terms with claims that encompass that original invention along with the broader embodiments of the invention not described in the first application, the later claims are not entitled to the earlier filing date of the first filed application.

359. Here, in my opinion, Patent Owner will be unable to show that the applications in the '105 patent family lineage prior to January 27, 2014 provide written description support for the full scope of any challenged claim. The patent applications to which the '105 patent's parent application claim priority do not include the expression "bowl fill restriction." The first time the term "restriction" appeared was January 27, 2014, the filing date of the application that issued as US 9,139,993, (the "'993 patent"), the '105 patent parent. *See* EX1008-103–EX1008-147. More specifically, the PO amended the Abstract and claims to eliminate any references to the bowl fill being "adjustable" and to a "bowl fill valve" in the preceding applications (*see, e.g.*, EX1012-055, EX1012-052–EX1012-054), and replaced that language with a "bowl fill restriction" (*see, e.g.*, EX1008-138, EX1008-133-EX1008-137). Ten days later, on February 6, 2014, PO filed preliminary remarks in which they explicitly stated that the independent claims reciting a "bowl fill restriction" were broader than "a bowl fill valve"—the only device disclosed that can control or adjust the flow through the bowl refill tube. EX1008-084–EX1008-085.

360. The expression "bowl fill restriction" is not used in the specification of the '105 patent, other than in the Abstract and claims. *See* '105 patent (EX1001). While a "bowl fill valve" is disclosed, a "bowl fill restriction" is not disclosed in the specification, nor do the terms "restriction" or "constricted" appear in the originally

filed specification. See '105 Patent File History (EX1002) at 124-143. There is no written description support for the full scope of the term “bowl fill restriction” if the term “bowl fill restriction” includes both restrictors and valves. While I do not agree that a bowl fill restriction includes a valve, even if a bowl fill restriction were construed to include both fixed restrictions and valves (which are adjustable), the full scope of the term “bowl fill restriction” would not have written description support because there is no written description support for a fixed restriction. Broadening the claims to include restrictors and adding references to restrictors in the Abstract added new matter that did not have support in the earlier applications.

361. The term “restriction” and the expression “bowl fill restriction” appear only in the Abstract and claims of the '105 patent. The specification refers to a coupling 203, 303, between the bowl fill outlet port 206 and the bowl fill valve inlet port 213, but a POSITA would not have considered any of the couplings illustrated in Figures 5-7 as described in the '105 patent as a fixed restriction.

362. Fluid flow restrictors or diverters lacked the key feature of adjustability provided by a valve. *See, e.g.*, Brown (EX1021), 4:37-44. Once installed, a restrictor or diverter is incapable of being adjusted. Accordingly, a POSITA would not have reasonably considered a fluid flow valve to be the same or equivalent to a fluid flow restrictor, or vice versa.

363. A POSITA would not have read the '904 application to have disclosed a system with a fixed restrictor that cannot be adjusted. Not only does the '904 application only disclose and claim a system with a bowl fill valve rather than a restrictor, it makes repeated references to the desirability and advantages of the adjustability function of the bowl fill valve (which is lacking in a restrictor).

364. The title of every patent application in the '105 patent priority chain, with the exception of the '993 patent, reads: "Toilet Fill Valve *with Adjustable Bowl Fill Flow*." See EX1009-EX1010. When the '993 patent was filed on January 27, 2014, PO deleted "*with Adjustable Bowl Fill Flow*." Similarly, the Abstract of every one of these parent applications included the following concluding sentence: "***The bowl fill valve is configured to supply an adjustable flow of water*** out the bowl fill outlet port for filling a toilet bowl during a flush cycle of a toilet." *Id.*, Abstract, emphasis added. But when the '993 patent was filed, this sentence was replaced with a discussion of a bowl fill restriction, without any reference to adjustability. EX1007, Abstract.

365. The following are excerpts from the '904 application that disclose the desirability of having an adjustable bowl fill valve in order to prevent wasted water:

By virtue of the manual setting of the handle 119 of the bowl fill valve 109, the flow of water through the bowl fill valve 109 is regulated...so that enough water flows out of the bowl fill valve 109 to fill the toilet bowl without wasting any water down a drain.

EX1010, 157; *see also, id.*, 163.

If the amount of water that flows into the toilet bowl is inadequate to refill the toilet bowl during the flush cycle as described above, the one should repeat the steps of adjusting the bowl fill valve....

Id., 160.

During the life cycle of the bowl fill valve 203, it may be possible that the bowl fill valve 203 is adjusted to take into account various changes in the operation of the toilet fill valve 200 such as, for example, changes in pressure of other operational changes.

Id., 161-162.

366. The '904 application specification makes it clear that the adjustability of the bowl fill valve is a desirable and essential feature of the invention. Because a fluid flow restrictor is not capable of being adjusted once installed, replacing the bowl fill valve of the '904 application with a non-adjustable restricting mechanism would defeat the purpose of the invention.

367. Indeed, during prosecution of the grandchild application of the '105 patent, Patent Owner argued that a prior art fluid flow restriction device (backflow prevent assembly) “does not serve as a substitute for the toilet fill valve of claim 1.” Prosecution History of Appl. No. 16/686,328 (EX1006), 56. The intrinsic evidence makes it clear that Patent Owner did not consider a fluid flow restrictor, or a fluid flow diverter, to be a bowl fill valve, as that expression is used in the '904 application specification.

368. The '904 application makes it clear that the inventors did not consider a bowl fill valve to be any device that can restrict or constrict flow, but rather must be a valve: “The bowl fill valve 109 may be, for example, a ball valve, a gate valve, a globe valve....or any other appropriate type of valve....” Prosecution History for '904 Application (EX1010), 158 ([0019]). Every embodiment disclosed for a bowl fill valve required some type of valve, including “any other appropriate type of valve.” If the '904 application inventors had intended any mechanism capable of restricting fluid flow to be a bowl fill valve, the inventors had every opportunity to disclose such a mechanism, but did not do so.

369. In view of the foregoing, a POSITA would not have understood the '904 application inventors to have had possession at the time of its filing, of a system with a restriction in place of a bowl fill valve. Thus, the earliest effective filing date of the '105 patent claims therefore would be at best January 27, 2014.

2. Independent Claims 1 and 24 are Anticipated by Schuster

a) 1[Pre], 24[Pre]

370. Claims 1 and 24 each recite “[a] system, comprising: a toilet fill valve ...; a bowl fill restriction ...; and a tube ...” Figures of Schuster are provided below, each of which depicts a system containing these three elements. Schuster discloses a system 200 including a toilet fill valve. Schuster (EX1029), Abstract, Figs. 3-4. As such, Schuster satisfies the preamble of claims 1 and 24.

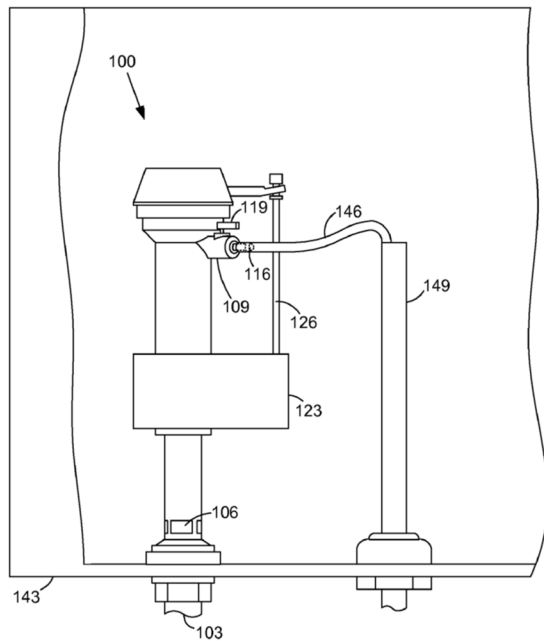


FIG. 3

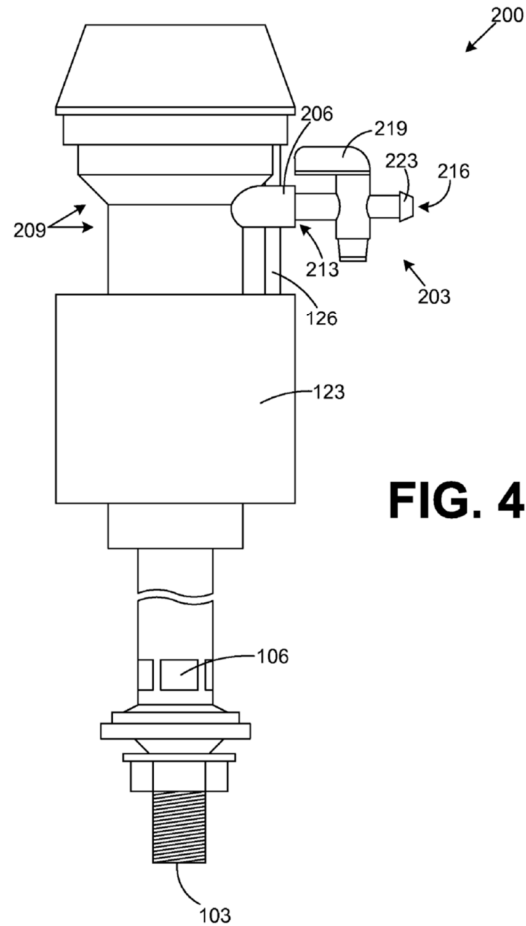


FIG. 4

b) 1[A], 24[A]

371. Claim element **1[A]** recites “a toilet fill valve that comprises: a body comprising an extended portion, wherein the extended portion is integrally molded with the body, wherein the extended portion forms a bowl fill outlet port....” ’105 patent, claim 1.

372. Similarly, claim element **24[A]** recites “a toilet fill valve that comprises: a body comprising an extended portion that forms a bowl fill outlet port, wherein the extended portion is integrally molded with the body” ’105 patent, claim 24.

373. Schuster discloses a toilet fill valve having an extended portion 206 that is integrally molded with the water toilet fill valve, as shown in Figure 4 above. Schuster thus satisfies these elements.

c) Claim Elements 1[B], 24[B]

374. Claim element **1[B]** recites “a water inlet configured to receive water from a water source...” ’105 patent, claim 1.

375. Claim element **24[B]** also recites “a water inlet configured to receive water from a water source” ’105 patent, claim 24.

376. Schuster discloses “water inlet 103 at the bottom of the toilet fill valve 100 that is configured to be coupled to a water source.” Schuster (EX1029), 1:63-65; Thus, Schuster satisfies these elements.

d) Claim Elements 1[C], 24[C]

377. Claim element **1[C]** recites “a tank water outlet configured to provide a first portion of the water to a toilet tank during at least a portion of a flush cycle....” ’105 patent, claim 1.

378. Claim element **24[C]** also recites “a tank water outlet configured to provide a first portion of the water to a toilet tank during at least a portion of a flush cycle....” ’105 patent, claim 24.

379. Schuster discloses one or more outlets 106 configured to supply water to a toilet tank. Schuster (EX1029), 2:1-3, Figs 1 and 3-4. Schuster thus discloses a tank water outlet, as is conventional in the art, and thereby satisfies these elements.

e) Claim Elements 1[D1], 24[D1]

380. Claim element **1[B]** recites “a bowl fill restriction configured to attach directly to the extended portion of the body....” ’105 patent, claim 1.

381. Claim element **24[D1]** also recites “a bowl fill restriction configured to attach directly to the extended portion of the body of the toilet fill valve....” ’105 patent, claim 24.

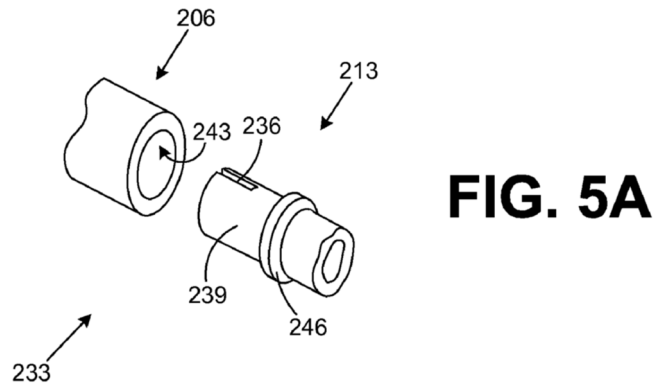
382. Schuster discloses a bowl fill valve configured to attach directly to the extended portion of the body. Schuster (EX1029), 2:18-21, Figs. 1 and 4. Thus, Schuster satisfies this element.

f) Claim Element 1[D2]

383. Claim element **1[D2]** recites “wherein the bowl fill restriction comprises a protrusion that is configured to insert into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the body....” ’105 patent, claim 1.

384. Schuster discloses a protrusion on the bowl fill valve that is configured to insert into a recess in the bowl fill outlet 206 of the toilet fill valve. That protrusion

is snap fit or locked into place when inserted. *See* Schuster (EX1029), 6:48-50; 7:25-47, Fig. 5A shown below. Thus, Schuster satisfies this element.



g) Claim Element 24[D2]

385. Claim element **24[D2]** recites “wherein the bowl fill restriction comprises means for locking the bowl fill restriction to the extended portion of the body of the toilet fill valve....” ’105 patent, claim 24.

386. As discussed above with respect to **1[D2]**, Schuster discloses means for locking the bowl fill restriction to the extended portion of the body of the toilet fill valve and thus satisfies this element.

h) Claim Elements 1[D3], 24[D3]

387. Claim element **1[D3]** recites “wherein the bowl fill restriction is configured to receive a second portion of the water from the bowl fill outlet port during at least a portion of the flush cycle....” ’105 patent, claim 1.

388. Claim element **24[D3]** also recites “wherein the bowl fill restriction is configured to receive a second portion of the water from the bowl fill outlet port during at least a portion of the flush cycle....” ’105 patent, claim 24.

389. Schuster discloses a first portion of water flow exiting the fill valve through holes 106, and a second portion exiting through the extended portion and into bowl fill valve via outlet port 206. Schuster (EX1029), Abstract; 3:3-17. Thus, Schuster satisfies these elements.

i) Claim Elements 1[D4], 24[D4]

390. Claim element **1[D4]** recites “wherein the restriction is configured to constrict a flow rate of the second portion of the water that flows through the bowl fill restriction....” ’105 patent, claim 1.

391. Claim element **24[D4]** also recites “wherein the restriction is configured to constrict a flow rate of the second portion of the water that flows through the bowl fill restriction....” ’105 patent, claim 24.

392. Schuster discloses bowl fill valve with an adjustable handle that can control the flow rate of water exiting the fill valve. Schuster (EX1029), 4:4-48. Regulating or controlling the flow of water through such a valve inherently constricts the flow. Thus, Schuster satisfies these elements.

j) Claim Elements 1[E], 24[E]

393. Claim element **1[E]** recites “a tube that is configured to attach directly to the bowl fill restriction, wherein the tube is configured to direct the second portion of the water from the bowl fill restriction directly to a toilet tank overflow tube.” ’105 patent, claim 1.

394. Claim element **24[E]** also recites “a tube configured to attach directly to the bowl fill restriction, wherein the tube is configured to direct the second portion of the water from the bowl fill restriction to a toilet tank overflow tube.” ’105 patent, claim 24.

395. Schuster discloses tube 146 directly attached directly to the bowl fill valve. Schuster (EX1029), 3:54-65, Fig. 4. Thus, Schuster satisfies these elements.

3. Independent Claim 9 is Anticipated by Schuster

396. Independent claim 9 recites a method that inherently happens when the toilet fill valve of Schuster is in operation. Claim 9 is fundamentally nothing more than the method (steps) performed when using the system of claims 1 and 24 – i.e., the system of Schuster.

a) Claim Elements 9[Pre], 9[A]

397. Claim elements **9[Pre]** and **9[A]** recite, respectively, “[a] method, comprising” and “receiving, via a water inlet of a toilet fill valve, water from a water supply.” ’105 patent, claim 9.

398. Schuster discloses receiving water via a water inlet, as is conventional and necessary for a toilet fill valve to operate. Schuster (EX1029), 1:63-67, Fig. 1. Thus, Schuster satisfies these elements.

b) Claim Element 9[B]

399. Claim element 9[B] recites “providing, via a tank water outlet of the toilet fill valve, a first portion of the water to a toilet tank....” ’105 patent, claim 9.

400. Schuster discloses one or more outlets 106 configured to supply water to a toilet tank. Schuster (EX1029), 2:1-3, Figs 1 and 3-4. Thus, Schuster discloses a tank water outlet, thereby satisfying this element.

c) Claim Element 9[C1]

401. Claim element 1[C1] recites “providing, via a bowl fill outlet port of the toilet fill valve, a second portion of the water to a bowl fill restriction, wherein an extended portion of the toilet fill valve forms the bowl fill outlet port....” ’105 patent, claim 1.

402. Schuster discloses a first portion of water flow exiting the fill valve through holes 106, and a second portion exiting through the extended portion and into bowl fill valve via outlet port 206. Schuster (EX1029), Abstract, 3:3-17. Thus, Schuster satisfies this element.

d) Claim Element 9[C2]

403. Claim element 9[C2] recites “wherein the extended portion is integrally molded with the toilet fill valve....” ’105 patent, claim 9.

404. In view of the discussion of **1[A], 24[A]**, Schuster satisfies this element.

e) Claim Element 9[C3]

405. Claim element **9[C3]** recites “wherein the bowl fill restriction is in direct contact with the extended portion of the toilet fill valve...” ’105 patent, claim 9.

406. In view of the discussion of **1[D1]**, Schuster satisfies this element.

f) Claim Element 9[C4]

407. Claim element **9[C4]** recites “wherein the bowl fill restriction is constructed as a single piece...” ’105 patent, claim 9.

408. Schuster discloses a bowl fill valve that is “integral” with the toilet fill valve, which includes being constructed as a single piece. Schuster (EX1029), 4:49-62, Fig. 4. Schuster therefore satisfies this element.

g) Claim Element 9[C5]

409. Claim element **9[C5]** recites “wherein the bowl fill restriction causes a flow of the second portion of the water to be constricted...” ’105 patent, claim 9.

410. Schuster satisfies this element for the same reasons discussed above with respect to **1[D4], 24[D4]**.

h) Claim Element 9[D]

411. Claim element **9[D]** recites “providing, via the bowl fill restriction, the second portion of the water to a tube that is in direct contact with the bowl fill

restriction; and providing, via the tube, the second portion of the water to a toilet tank overflow tube.” ’105 patent, claim 9.

412. Figure 3 of Schuster (EX1029) illustrates tube 146 directing a second portion of water to a toilet tank overflow tube 149 and thus discloses this element. See discussion of 1[E], 24[E] above.

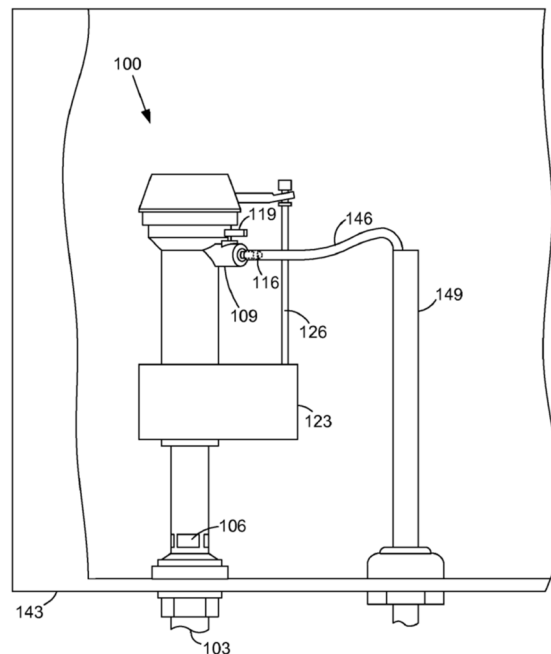


FIG. 3

4. Independent Claim 15 is Anticipated by Schuster

413. Independent claim 15 recites a method that inherently happens when the toilet fill valve of Schuster is assembled. Claim 15 is fundamentally nothing more than the method (steps) performed when assembling the system of claims 1 and 24 – i.e., the system of Schuster. Moreover, fabricating various parts separately and

designing the separate parts for easy assembly would have been considered obvious design parameters and/or obvious and routine optimization to a POSITA prior to the '105 patent filing date.

a) Claim Element 15[Pre]

414. Claim element **15[Pre]** recites “[a] method, comprising....” ’105 patent, claim 15.

415. To the extent any of the respective pieces of the toilet fill valve and bowl fill restrictions disclosed by Schuster are assembled prior to operation of the toilet fill valve, Schuster inherently discloses a method of assembling the respective parts. *See* Schuster (EX1029), claim 9, Fig. 8.

b) Claim Element 15[A1]

416. Claim element **15[A1]** recites “attaching a bowl fill restriction directly to an extended portion of a body of a toilet fill valve, wherein the extended portion is integrally molded with the body....” ’105 patent, claim 15.

417. Schuster satisfies this limitation for the reasons discussed with respect to **1[A]**, **24[A]** **1[D1]**, **24[D1]**, **9[C2]**, and **9[C3]** above.

c) Claim Element 15[A2]

418. Claim element **15[Pre]** recites “wherein the extended portion forms a bowl fill outlet port, wherein the bowl fill restriction is configured to constrict a flow rate of water that flows out of the bowl fill outlet port” ’105 patent, claim 15.

419. Prior art that discloses the direct attachment of a bowl fill restriction to an extended portion of the toilet fill valve will inherently satisfy this element of the claims. As discussed with respect to **1[A]**, **24[A]**; **1[D4]**, **24[D4]**, **9[C1]**, and **9[C5]** above. Schuster satisfies this element.

d) Claim Element 15[B]

420. Claim element **15[B]** recites “inserting a protrusion of the bowl fill restriction into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the body....” ’105 patent, claim 15.

421. For the same reasons discussed above with respect to **1[D2]**, Schuster satisfies this element.

e) Claim Element 15[C]

422. Claim element **15[C]** recites “attaching a tube directly to the bowl fill restriction, wherein the tube is configured to direct the water from the bowl fill restriction directly to a toilet tank overflow tube.” ’105 patent, claim 15.

423. For the same reasons discussed above with respect to **1[E]**, **24[E]**, and **9[D]**, Schuster satisfies this element.

5. Summary of Opinions Regarding Claims 1, 9 15, and 24

424. In sum, Schuster discloses all of the elements, and anticipates independent claims 1, 9 15, and 24 of the ’105 patent.

6. Dependent Claims 2-8, 10-14, and 16-23 are Anticipated by Schuster

a) Claim 2

425. Dependent claim 2 recites “[t]he system of claim 1, wherein the extended portion of the body extends radially from a longitudinal axis of the toilet fill valve.” ’105 patent, claim 2.

426. Schuster shows in Figure 1 thereof the extended portion extending radially from a longitudinal axis of the fill valve and thus anticipates claim 2.

b) Claim 3

427. Dependent claim 3 recites “[t]he system of claim 1, wherein a portion of the bowl fill restriction is configured to insert into the extended portion of the body.” ’105 patent, claim 3.

428. Claim 3 does not further limit claim 1 and recites the same limitation as recited by 1[D2]. Regardless, Schuster anticipates claim 3 for the same reasons discussed above with respect to element 1[D2].

c) Claims 4 and 5

429. Dependent claim 4 recites “[t]he system of claim 1, wherein the bowl fill restriction is configured to be clamped to the extended portion of the body.” ’105 patent, claim 4.

430. Dependent claim **5** recites “[t]he system of claim 1, wherein the bowl fill restriction is configured to be snapped onto the extended portion of the body.” ’105 patent, claim 5.

431. Schuster discloses: “bowl fill valve 109 may be molded as a portion of the toilet fill valve 100 or it may be snapped or clamped into place, or it may be attached to the toilet fill valve 100 in some other manner, etc.” Schuster (EX1029), 2:18-21. Thus, Schuster anticipates claims 4 and 5.

d) Claim 6

432. Claim **6** recites “[t]he system of claim 1, wherein the toilet fill valve further comprises: a float; and an actuating arm coupled to the float, wherein the actuating arm extends radially relative to a longitudinal axis of the toilet fill valve, wherein the actuating arm is angularly offset relative to the bowl fill valve, thereby preventing an interference with the bowl fill restriction and a translational stem that extends from the float to a free end of the actuating arm.” ’105 patent, claim 6.

433. With reference to Figures 1 (left) and 2 (right) of Schuster below, Schuster discloses a float 123 attached to an actuating arm 129 via translational stem 126 in which the actuating arm is angularly offset relative to the bowl fill valve 109 to prevent interference with the bowl fill restriction and thus anticipates claim 6.

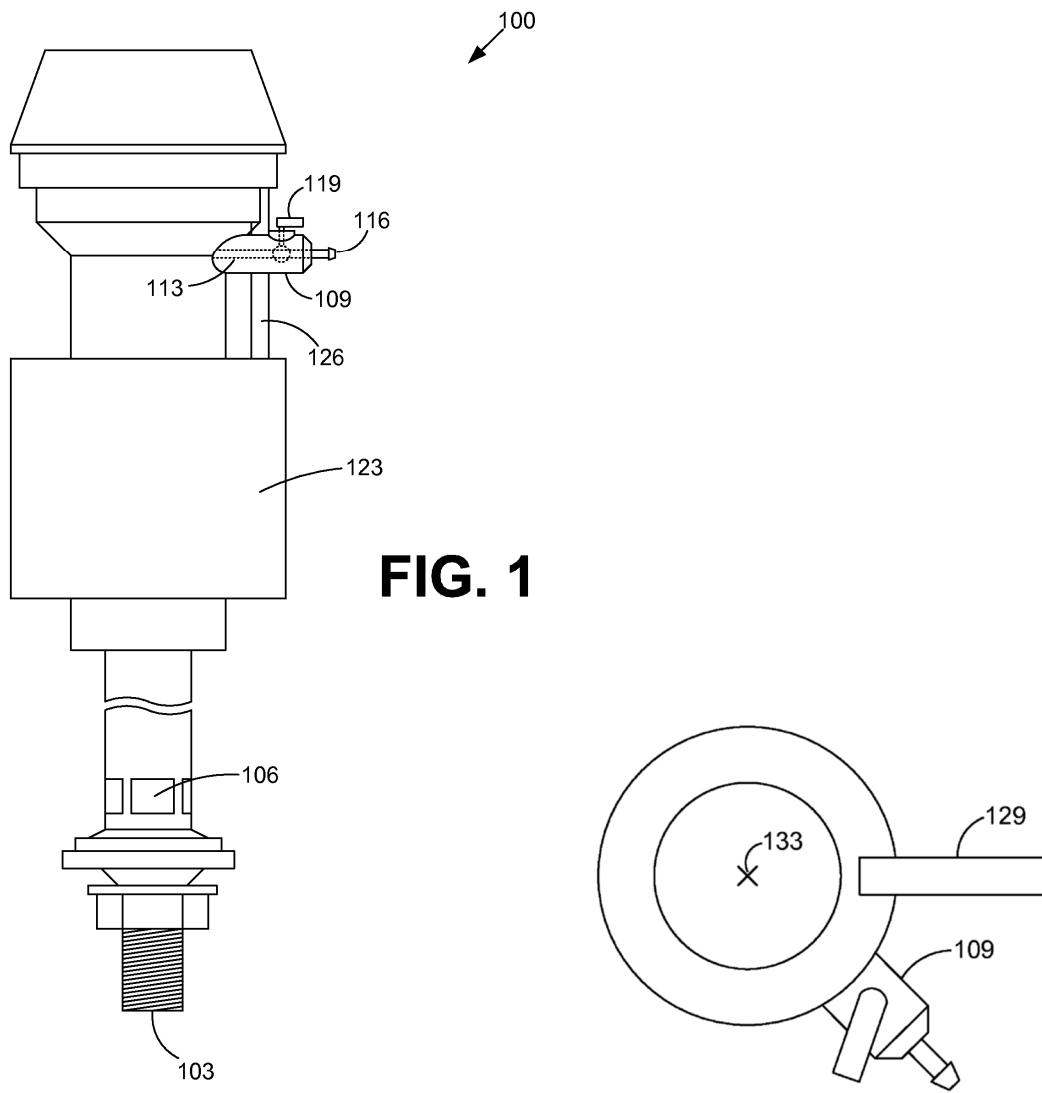


FIG. 1

e) Claim 7

434. Dependent claim 7 recites “[t]he system of claim 1, wherein the bowl fill restriction further comprises a nipple that is configured to insert into the tube.” ’105 patent, claim 7.

435. As discussed above with respect to claims 4 and 5, Schuster discloses a connection between fluid flow channels in which one end comprises a nipple with

annular ridges that is inserted into a tube that directs water from the water flow regulator to the toilet tank overflow tube. Schuster therefore anticipates claim 7.

f) Claim 8

436. Claim 8 recites “[t]he system of claim 1, wherein the bowl fill restriction being attached directly to the extended portion of the body prevents a pressure head from being formed in the tube.” ’105 patent, claim 8.

437. Claim 8 is expressly disclosed by Schuster. Schuster states that “the fact that the bowl fill valve 109 is integral with the toilet fill valve 100 prevents the creation of a pressure head in the tube 146 as would be the case if the bowl fill valve 109 were included in the middle of the tube 146.” Schuster (EX1029), 3:67-4:3. Thus, Schuster anticipates claim 8.

g) Claim 10

438. Claim 10 recites “[t]he method of claim 9, wherein the bowl fill restriction being in direct contact with the extended portion of the toilet fill valve prevents a pressure head from being formed in the tube.” ’105 patent, claim 10.

439. Claim 10 is anticipated by Schuster for the same reasons discussed above with respect to claim 8 above.

h) Claims 11 and 12

440. Claim 11 recites “[t]he method of claim 9, further comprising terminating, using the toilet fill valve, the flow of the second portion of the water so that a water level in a toilet bowl is at a predefined level.” ’105 patent, claim 11.

441. Claim **12** recites “[t]he method of claim 11, wherein the water level is determined at least in part by the bowl fill restriction.” ’105 patent, claim 12.

442. Schuster discloses adjusting the bowl fill valve so that the flow of the second portion of water is terminated at the same time as the flow of first portion, and that the flow is terminated when the water level in the toilet bowl is at a predetermined level. Schuster (EX1029), 3:54-4:28. Schuster therefore anticipates claims 11 and 12.

i) Claims 13 and 14

443. Dependent claim **13** recites “[t]he method of claim 9, wherein the extended portion of the toilet fill valve is a portion of a body of the toilet fill valve.” ’105 patent, claim 13.

444. Dependent claim **14** recites “[t]he method of claim 9, wherein the extended portion of the toilet fill valve extends radially from a longitudinal axis of the toilet fill valve.” ’105 patent, claim 14.

445. Claims 13 and 14 are anticipated by Schuster for the same reasons discussed above with respect to claim elements **1[A]**, **24[A]**, **15[A1]** and claim 2.

j) Claims 16-18

446. Dependent claim **16** recites “[t]he method of claim 15, further comprising preventing the bowl fill restriction from detaching from the extended portion of the body.” ’105 patent, claim 16.

447. Dependent claim **17** recites “[t]he method of claim 16, wherein preventing the bowl fill restriction from detaching from the extended portion further comprises clamping the bowl fill restriction to the extended portion.” ’105 patent, claim 17.

448. Dependent claim **18** recites “[t]he method of claim 16, wherein preventing the bowl fill restriction from detaching from the extended portion further comprises snapping the bowl fill restriction to the extended portion.” ’105 patent, claim 18.

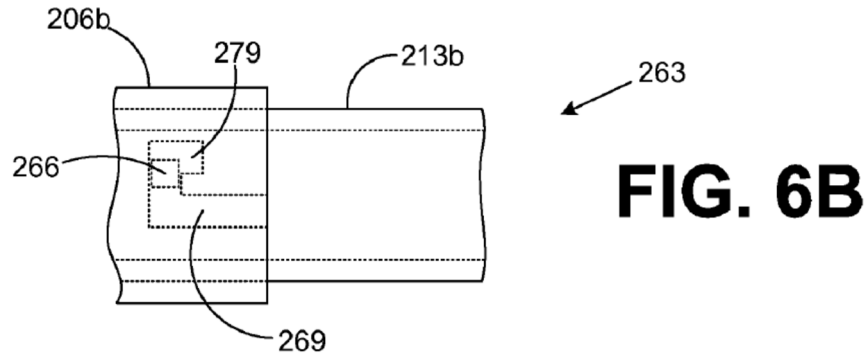
449. Schuster discloses the use of a snapping or clamping arrangement to couple the bowl fill valve to the toilet fill valve and prevent detachment thereof, as discussed above with respect to dependent claims 4 and 5. Schuster (EX1029), 2:18-21. Thus, Schuster anticipates claims 16-18.

k) Claim 19

450. Dependent claim **19** recites “[t]he method of claim 16, wherein preventing the bowl fill restriction from detaching from the extended portion further comprises rotating the bowl fill restriction with respect to the extended portion.” ’105 patent, claim 19.

451. With reference to Figure 6B below, Schuster discloses the use of locking ears 266 and corresponding locking grooves 269 that lock the bowl fill valve

to the toilet fill valve and prevent detachment therefrom. Schuster (EX1029), 7:25-47, Fig. 6B below. Thus, Schuster anticipates claim 19.



l) Claim 20

452. Dependent claim **20** recites “[t]he method of claim 15, wherein attaching a bowl fill restriction directly to the extended portion of the body of the toilet fill valve further comprises inserting a portion of the bowl fill restriction into the extended portion of the body.” ’105 patent, claim 20.

453. Claim 20 is anticipated by Schuster for the same reasons discussed above with respect to claim 3.

m) Claims 21 and 23

454. Dependent claim **21** recites “[t]he system of claim 1, wherein the bowl fill restriction is constructed of a single piece.” ’105 patent, claim 21.

455. Dependent claim **23** recites “[t]he method of claim 15, wherein the bowl fill restriction is constructed of a single piece.” ’105 patent, claim 23.

456. Claims 21 and 23 are anticipated by Schuster for the same reasons discussed above with respect to 9[C4].

n) Claim 22

457. Dependent claim 22 recites “[t]he method of claim 9, wherein the bowl fill restriction comprises a protrusion that is configured to insert into a recess in the toilet fill valve to lock the bowl fill restriction to the extended portion of the toilet fill valve.” ’105 patent, claim 22.

458. Claim 22 is anticipated by Schuster for the same reasons discussed above with respect to 1[D2], 24[D2], and claim 7.

IX. MOTIVATION TO COMBINE REFERENCES

459. I understand that one consideration made when determining whether prior art references can be combined is whether the products or subject matter described in the printed publications are within the same class or category of devices, addressing the same problem or market need, and would benefit from the same improvement or innovation. I considered these questions when forming my opinions about motivations to combine the prior art references and products discussed herein.

460. I am of the opinion that all of the prior art references and products considered in this declaration teach or disclose devices that fall within the same category—flush toilet components or components that can be used with a flush toilet.

461. The developers of these references faced similar technical and design challenges and decisions. For example, Quick Connection Art are similar enough to the other references discussed to share similar mechanical design issues, and a POSITA would have understood how to apply the teachings of Quick Connection Art to the issues presented by a fluid flow coupling designed to work with the fill valves of the other prior art references discussed.

462. To the extent PO alleges that one of the primary prior art references discussed herein do not disclose a limitation of the Challenged Claims, the limitation would be rendered obvious by a secondary prior art reference and its teachings cited above, as well as in view of the knowledge of a person of ordinary skill in the art. The combination would render the challenged claim obvious for the reasons stated in this declaration.

463. A person of ordinary skill in the art would be familiar with a variety of possible mechanical designs to implement a valve for a toilet, and more generally, mechanical designs for connecting valves and fluid flow components. One of skill in the art would understand that substituting the structure in a prior art reference with the exact structure recited in this claim element was an obvious design choice, requiring no more than routine experimentation. Such a modification would simply apply one of a finite number of well-known techniques or structural features in a predictable manner, to achieve well-known, predictable results.

464. A person of ordinary skill in the art would be motivated to combine the primary prior art reference with the references discussed herein and/or with the knowledge of a person of ordinary skill in the art at least because they address common problems and provide overlapping teachings, such that it would have been obvious for a person of ordinary skill in the art to try, and because it is also a combination of prior art elements using known methods, or substitution of one prior art element for another, to yield predictable results.

465. To the extent Patent Owner contends that any other limitation is missing from a primary prior art reference, it would have been obvious for a person of skill in the art to modify the reference and include that limitation for the reasons discussed herein.

X. SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

466. I understand that secondary considerations of non-obviousness are not part of the prima facie obviousness analysis but can be used to rebut allegations of obviousness.

467. To the extent Patent Owner attempts to rely on any secondary considerations of non-obviousness, I reserve the right to address those at a later time.

XI. CONCLUDING REMARKS

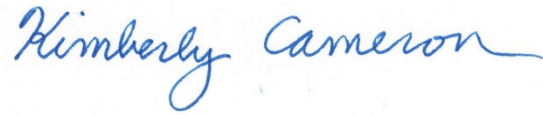
468. I understand that any additional rulings regarding claim construction, any change in position on claim construction by the parties, or on receipt of any

additional relevant information, may require me to amend or supplement my opinions. I will do so in a timely manner should a response to that additional information, changed position on claim construction, or ruling relevant to claim construction be warranted.

469. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the results of these proceedings.

[SIGNATURE ON FOLLOWING PAGE]

Dated: March 3, 2024



Kimberly K. Cameron, Ph.D.

APPENDIX A



KIMBERLY K. CAMERON, Ph.D., P.E.
PRINCIPAL

kkcameron@engsys.com

Dr. Kimberly Cameron is a Principal for ESi in the Mechanics and Materials practice. She specializes in design, failure analysis, and risk assessments of engineering structures and components. She has conducted hundreds of investigations on a wide variety of engineering structures, from miniature biomedical devices to large scale process equipment. She has also taught classes for engineers preparing to take the fundamentals of engineering exam and the professional engineering licensing examination in both Civil Engineering and Mechanical Engineering.

Dr. Cameron has performed multidisciplinary investigations on biomedical devices, pipelines, consumer electronics, consumer products, aircraft structures, industrial machinery, heat exchangers and cooling fins, refrigeration products, power-plant components, solar panels, pressure vessels, and vehicle components. The common thread in each of Dr. Cameron's investigations is the application of the fundamentals of metallurgy, materials science, engineering physics, computational mathematics, and engineering mechanics to help understand and solve complex problems.

Dr. Cameron is a registered patent agent, with experience in both the patent application process, as well as intellectual property disputes. In particular, she has experience in biomedical, automotive, electrical, mechanical, and materials science fields and has provided numerous invalidity and infringement reports. She has testified in federal and state court as well as in front of the ITC and in arbitration.

Areas of Specialization

Metallurgy	Product Design	Biomedical Devices
Plastics & Composites	Structural Engineering	Oil & Gas
Corrosion	Product Recalls	Energy & Power
Materials Selection	Root Cause Investigations	Consumer Products & Electronics
Mechanical Engineering	Regulatory Compliance	Automotive & Aviation
Intellectual Property Matters	Failure Analysis	Electrical Equipment

Education

Ph.D. Mechanical Engineering, minor Materials Science & Engineering, Stanford University, CA, 2004
M.S. Mechanical Engineering, Stanford University, CA, 2000
B.S.E. Mechanical and Aerospace Engineering. Certificates: Engineering Physics, Applied & Computational Mathematics, Materials Science & Engineering, Woodrow Wilson School of Public Policy & International Affairs, Princeton University, NJ, 1999

Licensed Professional Engineer (P.E.)

Mechanical Engineer, State of California License No. 33732
Metallurgical Engineer, State of California.....License No. 1969

Professional Affiliations/Honors

American Society of Mechanical Engineers

Member

TMS

Member

Department of Defense

Fellowship

National Science Foundation

Fellowship

Lucent Technologies

Graduate Fellowship

Positions Held

Engineering Systems Inc., Sunnyvale, California

Principal, Mechanics, 2011 – Present

Exponent, Menlo Park, California

Senior Engineer, Mechanics & Metallurgy, 2004 – 2011

Publications/Presentations

“Crack Growth and Arrest in Steam Turbine Casings,” EPRI 3002003504, EPRI, Palo Alto, CA, December 2014.

M. H. Anderson, D. Cislo, J. Saavedra, and **K. Cameron**, Why International Inventors Might Want to Consider Filing Their First Patent Application at the United States Patent Office & the Convergence of Patent Harmonization and E-Commerce, 30 Santa Clara High Tech. L.J. 555 (2014).

“Increasing Reliability of Small Punch Fracture Toughness Testing with Acoustic Emission Monitoring,” Proceedings, 3rd International Conference on Small Sample Test Techniques, September 2014. (with D. Purdy and J. Foulds).

“Small Punch Fracture Toughness Evaluation of Combustion Turbine Materials,” EPRI 3002001468, EPRI, Palo Alto, CA, December 2013. (with D. Purdy, J. Foulds and J. Rodgers).

“Small Punch Testing for Fracture Toughness” by J. Foulds, J. Rodgers, **K. Cameron** and P. Sullivan, EPRI, Palo Alto, CA: 2013. 3002000250.

“The Effect of Low Sulfur Content on the Weldability of Linepipe Steel” by **K. Cameron** and A.M. Pettinger, Proceedings of the 9th International Pipeline Conference, September 2012.

- “Effectiveness of Hydrostatic Testing for High Strength Pipe Material” by **K.K. Cameron** & A.M. Pettinger, Proceedings, 8th International Pipeline Conference, October 2010.
- “Axial Loads from Soil Movement Challenge Pipeline Integrity” by **K.K. Cameron** & A.M. Pettinger, PipeLine Gas Technology, November 2009.
- “Assessing Pipeline Integrity Using Fracture Mechanics and Currently Available Inspections Tools” by **K.K. Cameron** & A.M. Pettinger, Journal of Pipeline Engineering, October 2009.
- “Assessing Pipeline Integrity Using Fracture Mechanics and Currently Available Inspections Tools” by **K.K. Cameron** & A.M. Pettinger, Proceedings, 2008 Evaluation and Rehabilitation of Pipelines Conference, Clarion Technical Conferences, Scientific Surveys Ltd., Prague, Czech Republic, October 2008.
- “Fatigue Damage in Bulk Metallic Glass I: Simulation” by **K.K. Cameron** & R. Dauskardt, Scripta Materialia 2006; 54(3):349–353.
- “Fundamentals of Engineering in a Flash” by **K.K. Cameron**, PPI, August 2006.
- “Transmission Electron Microscopy Structure and Platinum-like Temperature Coefficient of Resistance in a Ruthenate-Based Thick Film Resistor with Copper Oxide” by **K.K. Cameron**, G. Crosbie, J. Jiang, & X. Pan, J. Appl. Phys. 2000; 88:1124–1128.

Selected Project Experience

Failure analysis, design analysis, material selection, mechanical testing, finite element analysis, fatigue and fracture evaluation, and development of various implantable medical devices including cardiovascular implants (heart valves, stents, catheters, pacemakers), orthopedic implants (screws, plates, pins, hip implants, spinal implants), cranial implants, etc.

Design and failure analysis of various fluid and drug delivery systems including implantable pumps, drug eluting stents, syringes, patches, microneedles, CPAP machines, anesthesia machines, insulin and other drug delivery pumps, balloon respirators, etc.

Design and failure analysis of other types of medical devices including surgical tools, scooters, hospital beds, physical therapy equipment, refrigerated portable coolers, etc.

Performed analyses to support FDA submissions.

Evaluated the design, pipeline integrity management program, in-line inspection tools, leak detection systems, control room management and operation and maintenance practices, of both liquid and gas pipeline systems under both 49 CFR 195 and 192.

Evaluated pipeline construction practices of various pipeline systems and performed pipeline failure investigations after various landslide events.

Assisted the Inter-American Development Bank with a pipeline integrity study and supervision of implementing a pipeline integrity management program. This included geotechnical site investigations, fracture mechanics, metallurgical investigations, in-line inspection data, and external inspection data.

Evaluated welding procedures and determined the effect of welding defects and other construction factors on pipeline integrity.

Evaluated pipe-soil interactions, mechanical and welded joints, welding procedures, in-line inspection tools, regulatory compliance, and the overall integrity of pipeline systems.

Failure analysis of various insulated steel oil and water pipeline systems, including behavior of the polyurethane foam and jacket materials.

Design evaluation and failure analyses of pipe couplings and fittings, including finite element analyses, as well as analysis of various plumbing fixtures and components.

Performed design and failure analyses of various gas distribution systems made of polyethylene and steel pipe, including the evaluation of compression couplings.

Retained as an expert for the United States Patent and Trademark Office in the evaluation of a patent claim dispute relating to large diameter pipes.

Evaluated the design of a hydrogenerator system. Performed a finite element analysis and fatigue analysis of the rotors, thrust bridge, and head cover to assess the design.

Evaluated the design of various pumps, rotors, bearings, seals and insulation systems.

Thermal analyses of industrial heat exchangers and cooling fins, nuclear reactor heads, and welds.

Failure analysis of various refrigeration systems and components and HVAC system components.

Performed design analysis of various solar panel system components and assisted in design changes to meet standardized safety testing.

Developed testing protocols and conducted failure analyses and design reviews for various consumer electronic devices and accessories, electrical connectors, power cords, and jacket sleeves.

Design of electrical connectors and various components of several consumer electronic devices including phones, tablets, and computers.

Design evaluation of various consumer products, including washing machines, refrigerators, various child containment products, hand and power tools, security and display systems, coffee machines, exercise machines, cooling sleeves and pads, consumer electronic accessories, breast pumps, baby bottles, etc.

APPENDIX B

ASSE International

PLUMBING DICTIONARY



Sixth Edition

Fluidmaster, Inc. - EX1004, Page 165
IPR2024-00634 (Fluidmaster Inc v. Danco Inc)

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Why do professionals become members of ASSE International?
(answers from an ASSE International membership survey)

"ASSE is a leader in the cross-connection control industry and I wanted to be a part of the organization."

"To maintain a relationship with a cross-section of people in the piping industry and to advance my career."

"My company partners and relies on ASSE to uphold standards and certification integrity."

"To become more familiar with my industry, keep up with the latest technology, ideas and discussions, and to be part of keeping our industry safe."

"The main reason was to stay in front of code changes and new technology, and to share this information with my co-workers."

"It is my professional responsibility to do so."



Fluidmaster, Inc. — ASSE International

18927 Hickory Creek Drive, Suite 220, Mokena, Illinois 1 (708) 995-3019 | <http://www.asse-plumbing.org>

IPR2024-00634 (Fluidmaster Inc v. Danco Inc)

ASSE International

PLUMBING DICTIONARY

Sixth Edition

Published by
ASSE International
18927 Hickory Creek Drive, Suite 220
Mokena, Illinois 60448

Edited by
ASSE Plumbing Nomenclature Committee
Carl Schroeder, FASSE, Chairman
Diana Corcoran, ASSE Staff Liaison

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Mokena, Illinois

All rights reserved. No part of this book may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording or by any information storage and retrieval system, without prior written permission in writing from the publisher.

Foreword

This edition is for practical and widespread use to fill a void in existing technical literature for this field of knowledge. It will be tested through use and improved as needed. It is to be expected that omissions will be discovered by readers and critics, and that some of the entries will engender criticism and comment. The Nomenclature Committee of ASSE International will welcome every criticism and suggestion for inclusions and deletions in future editions.

Almost every professional society has a nomenclature committee. Ours decided to venture where no one in plumbing had gone before us – that is, to this actual publication. It is a beginning.

Let special legal meanings be decided by constituted authorities and the courts. It is the purpose of this book to be “descriptive,” not prescriptive; to describe, define, and explain, and not to prescribe limitations or establish fixed and restrictive meanings; to record the words and combinations of words used in plumbing, and to give the definitions and meanings of these words and terms. Wherever possible, nontechnical language has been used, but specialized and technical terminology have been retained wherever necessary to help give the truest pertinent meanings. It is intended, thereby, that either the knowledgeable sanitarian or the student who seeks to learn, can rely on the information to be found in this book.

Plumbers’ work encompasses many fields of knowledge. Plumbing is affected by advancements in technology, new inventions, improvements of materials, and discoveries in seemingly unrelated fields. Similarly, the terminology of plumbing is derived from everyday human language, which is constantly changing. In this dynamic environment, the Nomenclature Committee of ASSE International collected the terms and words of plumbing for this Plumbing Dictionary.

This dictionary includes many words that are not common in daily speech. On the other hand, it has many words that are regularly used by everyone, but have become specialized and thus have, in the sense used, become plumbing terms – like “vent,” “fixtures,” and “water closet.” To prepare this book, we started to collect words and terms from plumbing trade publications, product catalogues, text books, plumbing code books, reference books, and dictionaries. We solicited lists from people in all phases of plumbing; from manufacturers, plumbers, plumbing inspectors, and educators ... and we are extremely grateful for the enthusiastic responses we received.

Trade names and brand names have been purposely omitted from this book. Several grammatical functions such as pronunciation symbols, inflectional forms, and etymologies have been omitted as they are in most technical dictionaries. When two or more words have similar meanings, or are used interchangeably, the definition given under the term is the most-used or preferred. Use of varied terms and meanings, due to geographical differences, has resulted, in several instances, in a polysemous entry (many meanings for the same word).

The main entry appears in bold type without capitalization. Filing is in strict alphabetical order by letter, without regard to spacing, hyphens, etc. – as shellac, orange, and shellac white; before shell, tank. A word having more than one syllable is usually divided into phonetic syllables, retaining correct spelling. This is shown in parenthesis. (pa-ren-the-sis).

Definitions are shown in sentence form. Wherever examples follow the definition sentence, the first word of the example sentence is capitalized. Cross-references are encouraged by use of “see” and “see also” in small letters, no punctuation; followed by the referred-to term.

Special acknowledgment and gratitude of all contributors to this edition is due to lexicographer Amy Jacobson for the dedication and diligence that provided the wealth of information that was gathered for the first edition. The Library of Congress in Washington, D.C., The Cleveland Public Library in Cleveland, Ohio, and The Library of The American University in Washington, D.C. were used at various stages in the preparation of this book. The committee resubmitted sections to the subject authorities for their comments and criticism, and thus were able to maintain cross-checks for accuracy and completeness. We were capably assisted in cross-referencing and in keeping format by our librarian, Amy Isaacs.

The pursuit of this project has given many great personal pleasures, not the least of which were the pleasures of friendships proved over and over again in the cooperation of all who participated in preparing this book. The patience shown and the encouragement given by ASSE officers and members is gratefully acknowledged. Since the work of all contributors was voluntary, it was performed in time not otherwise preempted in busy schedules. Perhaps this patience will be rewarded by the early establishment of a repository for a library of catalogues and a long list of tradenames, the beginnings of which has been collected by the Nomenclature Committee in the course of preparing this book.

Dedications

I.D. "BUDD" JACOBSON

ASSE International, by action of its Board of Directors, dedicates the Sixth Edition of the ASSE Plumbing Dictionary to I.D. (Budd) Jacobson, who, as Chairman of the Nomenclature Committee, originated the idea of the ASSE Plumbing Dictionary. Through his efforts, the first four editions of the Plumbing Dictionary were published – each containing more and more definitions and other information, to the point where the book is now used internationally as a basis for plumbing terminology. As its author, his name will be remembered for generations to come.

JOHN E. MATTHEWS, P.E.

ASSE International, by action of its Board of Directors, dedicates the Sixth Edition of the ASSE Plumbing Dictionary to John E. Matthews, P.E., through whose efforts the Fifth Edition of the Plumbing Dictionary was published.

Nomenclature Committee

SIXTH EDITION

Carl Schroeder – *Chairman, Michigan Chapter*

Sean Cleary – *Northeastern Pennsylvania Chapter*

Shannon M. Corcoran – *Northern Ohio Chapter*

Robert L. Cross – *Texas Gulf Coast Chapter*

Joseph Fugelo – *Pennsylvania Chapter*

Thomas Molnar – *New York Chapter*

Richard J. Prospal – *Northern Ohio Chapter*

flotation (*flo-ta-tion*) the collection of substances immersed in a liquid by taking advantage of variable specific gravities, or by the buoyancy produced by the evolution of gas by chemicals or heat.

flow controller (automatic) [*flow con-trol-ler (auto-mat-ic)*] a component or accessory which limits the maximum flow through the line in which it is installed and incorporates a pressure compensating restriction maintaining a substantially constant flow of water over its designed pressure range.

flow passages (*flow pas-sa-ges*) the openings, or passages, within the device through which water, or air, flows from the inlet to the outlet or to atmosphere.

flowing pressure (*flow-ing pres-sure*) See RUNNING PRESSURE.

flowing pressure differential (*flow-ing pres-sure dif-fer-en-tial*) the difference between initial and reduced flowing pressure.

flow passages (*flow pas-sages*) the openings or passages within the device through which water or air flows from the inlet to the outlet or to atmosphere.

flow pressure (*flow pres-sure*) the residual pressure in the water supply pipe at a faucet, pressurized flushing device, water outlet, or other endpoint device when in an open and flowing condition.

flow rate (*flow rate*) **1.** an empirical value of a rate of flow of a liquid or other mobile substances, expressed in an accepted unit of measure, through a pipe, fitting, valve, or device that characterizes its capacity **2.** the rate of flow of water, silt, or other mobile substance which emerges from an opening, pump, or turbine or passes along a conduit or channel, usually expressed as cubic feet per second, cubic meters per second, gallons per minute, or million gallons per day.

flow restricter (fixed) [*flow re-stric-ter (fixed)*] a component or accessory which incorporates a flow restricting orifice of fixed geometrical construction such that flow through the restricter does not self-adjust with fluctuation in pressure. See AUTOMATIC FLOW CONTROLLER.

flow valve (*flow valve*) **1.** a valve that closes when the velocity or the pressure gradient of the fluid passing through it reaches a certain value. **2.** a type of motor-operated valve.

flue (*flue*) **1.** the general term for the passages and conduits through which flue gases pass from the combustion chamber to the outer air. **2.** appliance flue: the flue passages within an appliance. **3.** chimney flue: a conduit for conveying the flue gases delivered into it by a vent connector to the outer air. **4.** a dilution flue: a passage designed to effect the dilution of flue gases with air before discharge from an appliance. **5.** vent connector: the conduit connecting an appliance with the chimney or gas vent.

flue cleaner (*flue clean-er*) a chemical of powder formation sprinkled onto the hot walls of a combustion chamber and used to dissolve unburned carbon in a heating appliance or flue.

flue collar (*flue col-lar*) a projection, or recess, provided to accommodate the vent connector or draft hood.

flue gas (*flue gas*) the mixture of gases resulting from combustion and other reactions in a furnace, passing through the smoke flue, composed largely of nitrogen, carbon dioxide, carbon monoxide, water vapor, and often sulfur dioxide. Sometimes serving as a source from which CO₂ and other compounds are recovered.

flue gases (*flue gas-es*) products of combustion and excess air.

flue loss (*flue loss*) the sensible heat and latent heat above room temperature of the flue gases leaving an appliance.



V. *Abbr.* for Vent.

vac. *Abbr.* for Vacuum.

vac. br. *Abbr.* for Vacuum Breaker.

vacuum (*vac-u-um*) **1.** pressure below atmospheric. **2.** a space absolutely devoid of matter; it is usually measured by the number of inches of mercury below atmospheric pressure, such as ten or twenty inches of mercury. *Abbr.* vac.

vacuum breaker (*vac-u-um break-er*) a device to prevent the creation, or formation, of a vacuum by admitting air at atmospheric pressure and used to prevent backsiphonage. *Abbr.* vac. br.

vacuum breaker, atmospheric or non-pressure type (*vac-u-um break-er, at-mos-pher-ic or non-pres-sure type*) an assembly containing a float-check, a check seat and an air inlet port. The flow of water into the body causes the float to close the air inlet port. When the flow of water stops, the float falls and forms a check valve against backsiphonage and at the same time opens the air inlet port to allow air to enter and satisfy the vacuum. A shutoff valve immediately upstream may be an integral part of the assembly. An atmospheric vacuum breaker is designed to protect against a health hazard (contaminant) under a backsiphonage condition only. *Abbr.* AVB. See ATMOSPHERIC VACUUM BREAKER.

vacuum breaker - pressure type (*vac-u-um breaker - pres-sure type*) an assembly containing an independently operating, internally loaded check valve and an independently operating, loaded air inlet

valve located on the discharge side of the check valve. The assembly shall be equipped with the properly located test cocks and tightly closing shutoff valves attached at each end of the assembly. This assembly is designed to protect against a health hazard (contaminant) under a backsiphonage condition only. *Abbr.* PVB. See PRESSURE TYPE VACUUM BREAKER.

vacuum breaker, spill resistant type (*vac-u-um break-er, spill re-sis-tant type*) a device to prevent backflow of non-potable material into the potable water supply caused by backsiphonage only.

vacuum cleaner (*vac-u-um clean-er*) an electrical appliance for cleaning, floors, carpets, tapestry or upholstered work, by suction. Also called vacuum sweeper.

vacuum relief valve (*vac-u-um re-lief valve*) **1.** a device which admits air to the system if and when the system is attempting to reduce its pressure to less than atmospheric. **2.** a device to prevent excessive vacuum in a water storage tank or heater.

vacuum sweeper (*vac-u-um sweep-er*) See VACUUM CLEANER.

vacuum system (*vac-u-um sys-tem*) a piping system in which the pressure is drawn below atmosphere.

valve (*valve*) **1.** a device by which the flow may be started, stopped, or regulated by a moveable part which opens, or obstructs, the passage. **2.** a type of lawn faucet. See TAP; FAUCET.

About ASSE International

ASSE International is an ANSI accredited standards developer and product certification body comprised of individual and sustaining members who represent all disciplines of the plumbing and mechanical industries. Its mission is to continually improve the performance, reliability and safety of plumbing and mechanical systems. ASSE's product performance standards, professional qualifications standards, professional certification and product listing programs are developed in the interest of public health and safety. ASSE's motto, "Prevention Rather than Cure," has guided the organization for over 100 years.

ASSE International maintains more than 50 product performance standards, ranging from double check and reduced pressure backflow preventers to dielectric pipe unions, with many more in the development stages. ASSE's product standards are minimum performance requirements for component parts of the plumbing system. These standards detail how a product is intended to function under normal operating conditions, not how it is designed or manufactured. ASSE also has multiple professional qualifications standards, jointly developed with the International Association of Plumbing and Mechanical Officials (IAPMO), including the ASSE/IAPMO/ANSI Series 5000, Cross-Connection Control Professional Qualifications Standard, and the ASSE/IAPMO/ANSI Series 6000, Professional Qualifications Standards for Medical Gas Systems Personnel.

ASSE standards are developed and revised under the ANSI accredited standards development process.

The ASSE Product Listing Program is an ANSI accredited third party certification body which operates in accordance with ISO Guide 65. With more than 1,000 product listings, this program is continually evolving and growing to meet the needs of the plumbing industry. ASSE's directory of listings is available free of charge and updated online daily. This permits both members and nonmembers to reference ASSE's Product Listing Directory during the design, installation or inspection process. The ASSE Seal gives inspectors, code officials, customers and users confidence of the product's performance within the plumbing system

In addition to certifying plumbing and mechanical products, ASSE International is also a third party certifier for professionals in the plumbing and mechanical industries. Cross-connection control professionals, medical gas personnel and installers/inspectors of residential potable water fire protection systems may be certified to one or more of the standards within the ASSE/IAPMO/ANSI professional qualification standards. Each individual must pass both a written and a practical examination on the criteria established in the course outline.

ASSE International's membership is a cross-section of the plumbing and mechanical industries, including contractors, engineers, inspectors, journeymen, apprentices, manufacturers and many others. This unique composition gives members the opportunity to exchange ideas and provides a forum where all sides can express their views. No other industry group provides such a wide range of information. Benefits of ASSE membership include the monthly eNewsletter and Backflow Prevent & Plumbing Standards (BPPS) magazine, discounts on all publication orders, voting rights at Annual Meetings and networking opportunities in all segments of the plumbing and mechanical industries.

Since 1906, the motto, "Prevention Rather Than Cure," has guided ASSE's activities in a wide range of programs designed to educate the industry and the public on the necessity of correct plumbing installations.

Appendix A

Temperature Conversion Table – Fahrenheit to Celsius

°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
-60.0	-51.1	40.0	4.4	86.0	30.0	132	55.6	178	81.1	300	148.9
-50.0	-46.6	41.0	5.0	87.0	30.6	133	56.1	179	81.7	310	154.4
-40.0	-40.0	42.0	5.6	88.0	31.1	134	56.7	180	82.2	320	160.0
-30.0	-34.4	43.0	6.1	89.0	31.7	135	57.2	181	82.8	330	165.6
-20.0	-28.9	44.0	3.7	90.0	32.2	136	57.8	182	83.3	340	171.1
-10.0	-23.3	45.0	7.2	91.0	32.8	137	58.3	183	83.9	350	176.7
0	-17.8	46.0	7.8	92.0	33.3	138	58.9	184	84.4	360	182.2
1.0	-17.2	47.0	8.3	93.0	33.9	139	59.4	185	85.0	370	187.8
2.0	-16.7	48.0	8.9	94.0	34.4	140	60.0	186	85.6	380	193.3
3.0	-16.1	49.0	9.4	95.0	35.0	141	60.6	187	86.1	390	198.9
4.0	-15.6	50.0	10.0	96.0	35.6	142	61.1	188	86.7	400	204.4
5.0	-15.0	51.0	10.6	97.0	36.1	143	61.7	189	87.2	410	210.0
6.0	-14.4	52.0	11.1	98.0	36.7	144	62.2	190	87.8	420	215.6
7.0	-13.9	53.0	11.7	99.0	37.2	145	62.8	191	88.3	430	221.1
8.0	-13.3	54.0	12.2	100	37.8	146	63.3	192	88.9	440	226.7
9.0	-12.8	55.0	12.8	101	38.3	147	63.9	193	89.4	450	232.2
10.0	-12.2	56.0	13.3	102	38.9	148	64.4	194	90.0	460	237.8
11.0	-11.7	57.0	13.9	103	39.4	149	65.0	195	90.6	470	243.3
12.0	-11.1	58.0	14.4	104	40.0	150	65.6	196	91.1	480	248.9
13.0	-10.6	59.0	15.0	105	40.6	151	66.1	197	91.7	490	254.4
14.0	-10.0	60.0	15.6	106	41.1	152	66.7	198	92.2	500	260.0
15.0	-9.4	61.0	16.1	107	41.7	153	67.2	199	92.8	525	273.9
16.0	-8.9	62.0	16.7	108	42.2	154	67.8	200	93.3	550	287.8
17.0	-8.3	63.0	17.2	109	42.8	155	68.3	201	93.9	575	301.7
18.0	-7.8	64.0	17.8	110	43.3	156	68.9	202	94.4	600	315.6
19.0	-7.2	65.0	18.3	111	43.9	157	69.4	203	95.0	625	329.4
20.0	-6.7	66.0	18.9	112	44.4	158	70.0	204	95.6	650	334.3
21.0	-6.1	67.0	19.4	113	45.0	159	70.6	205	96.1	675	357.2
22.0	-5.6	68.0	20.0	114	45.6	160	71.1	206	96.7	700	371.1
23.0	-5.0	69.0	20.6	115	46.1	161	71.7	207	97.2	725	385.0
24.0	-4.4	70.0	21.1	116	46.7	162	72.2	208	97.8	750	398.9
25.0	-3.9	71.0	21.7	117	47.2	163	72.8	209	98.3	775	412.8
26.0	-3.3	72.0	22.2	118	47.8	164	73.3	210	98.9	800	426.7
27.0	-2.8	73.0	22.8	119	48.3	165	73.9	211	99.4	825	441.0
28.0	-2.2	74.0	23.3	120	48.9	166	74.4	212	100	850	454.4
29.0	-1.7	75.0	23.9	121	49.4	167	75.0	213	100.6	875	468.3
30.0	-1.1	76.0	24.4	122	50.0	168	75.6	214	101.1	900	482.2
31.0	-0.6	77.0	25.0	123	50.6	169	76.1	215	101.7	925	496.1
32.0	0	78.0	25.6	124	51.1	170	76.7	220	104.4	950	510.0
33.0	0.6	79.0	26.1	125	51.7	171	77.2	230	110.0	975	523.9
34.0	1.1	80.0	26.7	126	52.2	172	77.8	240	115.6	1000	537.8
35.0	1.7	81.0	27.2	127	52.8	173	78.3	250	121.1		
36.0	2.2	82.0	27.8	128	53.3	174	78.9	260	126.7		
37.0	2.8	83.0	28.3	129	53.9	175	79.4	270	132.2		
38.0	3.3	84.0	28.9	130	54.4	176	80.0	280	137.8		
39.0	3.9	85.0	29.4	131	55.0	177	80.6	290	143.3		

Appendix B

General Conversion Factors

MULTIPLY	BY	TO OBTAIN
Feet/min.	0.01136	Miles/hr.
Feet/min	0.00508	Meter/sec.
Feet/sec.	0.6818	Miles/hr.
Feet/sec.	0.01136	Miles/min.
Feet/sec.	0.3048	Meter/sec.
Fluid ounces	29.57	milliliter
Gallons	0.3785	Cubic centimeters
Gallons	0.1337	Cubic feet
Gallons	231	Cubic inches
Gallons	4	Quarts (liq.)
Gallons	3.785	Liter
Gallons water	8.33	Pounds of water
Gallons/min.	0.002228	Cubic feet/sec.
Gallons/min.	8.0208	Cu. ft./hr.
Gallons/min. (GPM)	3.785	Liters/min.
Gallons/min. (GPM)	0.063	Liters/sec.
Gallons water/min.	6.0086	Tons water/24 hours
Inches	2.540	Centimeters
Inches	25.4	Millimeters
Inches of mercury	0.03342	Atmospheres
Inches of mercury	1.133	Feet of water
Inches of mercury	0.4912	Lbs./sq. inch
Inches of water	0.002458	Atmospheres
Inches of water	0.07355	Inches of mercury
Inches of water	5.202	Lbs./sq. ft.
Inches of water	0.03613	Lbs./sq. inch
Kilogram force	9.807	Newton
Liters	1000	Cubic centimeters
Liters	61.02	Cubic inches
Liters	0.2642	Gallons
Meters	3.281	Feet

MULTIPLY	BY	TO OBTAIN
Acres	43,560	Square feet
Acre-feet	43,560	Cubic feet
Acre-feet	325,851	Gallons
Atmospheres	76.0	Cms. of mercury
Atmospheres	29.92	Inches of mercury
Atmospheres	33.90	Feet of water
Atmospheres	14.70	Lbs./sq. inch
B.T.U./min.	12.96	Foot-lbs./sec.
B.T.U./min.	0.02356	Horse-power
Celsius	$9/5 \times ^\circ\text{C} + 32$	Fahrenheit
Centimeters	0.3937	Inches
Centimeters of mercury	0.01316	Atmospheres
Centimeters of mercury	0.4461	Feet of water
Centimeters of mercury	27.85	Lbs./sq. ft.
Centimeters of mercury	0.1934	Lbs./sq. inch
Cubic inches	16.387	Cubic centimeters
Cubic feet	1728	Cubic inches
Cubic feet	0.03704	Cubic yards
Cubic feet	7.48052	Gallons
Cubic feet	29.92	Quarts (liq.)
Cubic feet/minute	472.0	Cubic cms./sec.
Cubic feet/minute	0.1247	Gallons/sec.
Cubic feet/minute	62.43	Pounds of water/min.
Cubic feet/second	0.646317	Million gals./day
Cubic feet/second	448.831	Gallons/min.
Cubic yards	27	Cubic feet
Cubic yards	202.0	Gallons
Fahrenheit	$5/9 (\times ^\circ\text{F} - 32)$	Celsius
Feet	0.3048	Meters
Feet of water	0.02950	Atmospheres
Feet of water	0.8826	Inches of mercury
Feet of water	62.43	Lbs./sq. ft.
Feet of water	0.4335	Lbs./sq. inch
Feet/min.	0.01667	Feet/sec.

MULTIPLY	BY	TO OBTAIN
Miles	5280	Feet
Miles/hr.	88	Feet/min.
Miles/hr.	1.467	Feet/sec.
Millimeters	0.1	Centimeters
Millimeters	0.03937	Inches
Million gal./day	1.54723	Cubic ft./sec.
Pound force	4.448	Newton
Pounds	0.45359	Kilograms
Pounds of water	0.01602	Cubic feet
Pounds of water	27.68	Cubic inches
Pounds of water	0.1198	Gallons
Pounds/cubic inch	1728	Lbs./cubic foot
Pounds/sq. foot	0.01602	Feet of water
Pounds/sq. inch	0.06804	Atmospheres
Pounds/sq. inch	2.307	Feet of water
Pounds/sq. inch	2.036	Inches of mercury
Pounds/sq. inch	6.895	Kilopascal
Quarts (dry)	67.20	Cubic inches
Quarts (liq.)	57.75	Cubic inches
Quarts	0.9464	Liters
Square inches	645.2	Square millimeters
Square inches	6.452	Square centimeters
Square feet	144	Square inches
Square feet	0.09290	Square meters
Square miles	640	Acres
Square yards	9	Square feet
Temp. (°C.) + 273	1	Abs. Temp. (°C.)
Temp. (°C.) + 17.28	1.8	Temp. (°F.)
Temp. (°F.) + 460	1	Abs. Temp. (°F.)
Temp. (°F.) - 32	5.9	Temp. (°C.)
Tons (short)	2000	Pounds
Tons of water/24 hours	83.333	Pounds water/hour
Tons of water/24 hours	0.16643	Gallons/min.
Tons of water/24 hours	1.3349	Cu. ft./hr.

Appendix C

Inches and Fractions Expressed in Decimals of a Foot

Inches	0	1/8	1/4	3/8
0	0.0000	0.0104	0.0208	0.0313
1	0.0833	0.0937	0.1042	0.1146
2	0.1667	0.1771	0.1875	0.1979
3	0.2500	0.2604	0.2708	0.2813
4	0.3333	0.3438	0.3542	0.2646
5	0.4167	0.4271	0.4375	0.4479
6	0.5000	0.5104	0.5208	0.5313
7	0.5833	0.5938	0.6042	0.6146
8	0.6667	0.6771	0.6875	0.6979
9	0.7500	0.7604	0.7708	0.7813
10	0.8333	0.8438	0.8542	0.8646
11	0.9167	0.9271	0.9375	0.9479
12	1.0000	---	---	---

Inches	1/2	5/8	3/4	7/8
0	0.0417	0.0521	0.0625	0.0729
1	0.1250	0.1354	0.1458	0.1563
2	0.2083	0.2188	0.2292	0.2396
3	0.2917	0.3021	0.3125	0.3229
4	0.3750	0.3854	0.3958	0.4063
5	0.4583	0.4688	0.4792	0.4896
6	0.5417	0.5521	0.5625	0.5729
7	0.6250	0.6354	0.6458	0.6563
8	0.7083	0.7188	0.7292	0.7396
9	0.7917	0.8021	0.8125	0.8229
10	0.8750	0.8854	0.8958	0.9063
11	0.9583	0.9688	0.9792	0.9896
12	---	---	---	---

To convert to feet (or decimal of a foot) do the following:

$$\frac{(\text{inches} + \text{decimal fraction})}{12} = \text{decimal equivalent of a foot}$$

Appendix D

Decimal Equivalents

$1/64 = 0.015625$	$25/64 = 0.390625$	$49/64 = 0.765625$
$1/32 = 0.03125$	$13/32 = 0.40625$	$25/32 = 0.78125$
$3/64 = 0.046875$	$27/64 = 0.421875$	$51/64 = 0.796875$
$1/16 = 0.0625$	$7/16 = 0.4375$	$13/16 = 0.8125$
$5/64 = 0.078125$	$29/64 = 0.453125$	$53/64 = 0.828125$
$3/32 = 0.09375$	$15/32 = 0.46875$	$27/32 = 0.84375$
$7/64 = 0.109375$	$31/64 = 0.484375$	$55/64 = 0.859375$
$1/8 = 0.125$	$1/2 = 0.5$	$7/8 = 0.875$
$9/64 = 0.140625$	$33/64 = 0.515625$	$57/64 = 0.890625$
$5/32 = 0.15625$	$17/32 = 0.53125$	$29/32 = 0.90625$
$11/64 = 0.171875$	$35/64 = 0.546875$	$59/64 = 0.921875$
$3/16 = 0.1875$	$9/16 = 0.5625$	$15/16 = 0.9375$
$13/64 = 0.203125$	$37/64 = 0.578125$	$61/64 = 0.953125$
$7/32 = 0.21875$	$19/32 = 0.59375$	$31/32 = 0.96875$
$15/64 = 0.234375$	$39/64 = 0.609375$	$63/64 = 0.984375$
$1/4 = 0.25$	$5/8 = 0.625$	
$17/64 = 0.265625$	$41/64 = 0.640625$	
$9/32 = 0.28125$	$21/32 = 0.65625$	
$19/64 = 0.296875$	$43/64 = 0.671875$	
$5/16 = 0.3125$	$11/16 = 0.6875$	
$21/64 = 0.328125$	$45/64 = 0.703125$	
$11/32 = 0.34375$	$23/32 = 0.71875$	
$23/64 = 0.359375$	$47/64 = 0.734375$	
$3/8 = 0.375$	$3/4 = 0.75$	

Appendix E

Equivalents of Liquid Measures and Weights

Liquid Measure or Weight	U.S. Gallon	Imperial Gallon	U.S. Pint	U.S. Pound Water*
U.S. Gallon	1.0	0.833	8.0	8.337
Imperial Gallon	1.2009	1.0	9.60752	10.0
U.S. Pint	0.125	0.1041	1.0	1.042
U.S. Pound Water *	0.11995	0.1	0.9596	1.0
U.S. Cubic Foot	7.48052	6.22888	59.8442	62.365
U.S. Cubic Inch	0.004329	0.00361	0.034632	0.03609
Liter	0.2641779	0.2199756	2.113423	2.202
Cubic Meter	264.170	219.969	2113.34	2202.0

Liquid Measure or Weight	U.S. Cubic Foot	U.S. Cubic Inch	Liter	Cubic Meter
U.S. Gallon	0.13368	231.0	3.78533	0.003785
Imperial Gallon	0.16054	277.42	4.54596	0.004546
U.S. Pint	0.01671	28.875	0.473166	0.000473
U.S. Pound Water *	0.016035	27.708	0.45405	0.000454
U.S. Cubic Foot	1.0	1728.0	28.31702	0.028317
U.S. Cubic Inch	0.0005787	1.0	0.016387	0.0000164
Liter	0.0353154	61.02509	1.0	0.001000
Cubic Meter	35.31446	61023.38	999.972	1.0

*Water at 60.0 °F

1 Barrel = 42 gallons (petroleum measure)

Problem:

10 U.S. Gallons equals how many Imperial Gallons?

Solution:

The Imperial Gallon equivalent of 1 U.S. Gallon is 0.833.

Then, $10 \times 0.833 = 8.33$ Imperial Gallons.

Appendix F

Equivalents of Pressure and Head

Pressure or Head	lb./in. ²	lb./ft. ²	Atmospheres	kg/cm ²	kg/m ²
lb./in. ²	1.0	144.0	0.68046	0.070307	703.067
lb./ft. ²	0.0069445	1.0	0.000473	0.000488	4.88241
Atmospheres	14.696	2116.22	1.0	1.0332	10332.27
kg/cm ²	14.2234	2048.17	0.96784	1.0	10000.0
kg/m ²	0.001422	0.204817	0.0000968	0.0001	1.0
in water*	0.036092	5.1972	0.002456	0.00253	25.375
ft. water*	0.433103	62.3668	0.029471	0.03045	304.50
in mercury**	0.491157	70.7266	0.033421	0.03453	345.316
mm mercury **	0.0193368	2.78450	0.0013158		13.59509

Pressure or Head	in. water (60.0 °F)	ft. water (60.0 °F)	in. mercury (32.0 °F)	mm mercury (32.0 °F)
lb./in. ²	27.707	2.3039	2.03601	51.7148
lb./ft. ²	0.19241	0.01603	0.014139	0.35913
Atmospheres	407.17	33.931	29.921	760.0
kg/cm ²	394.08	32.840	28.959	735.559
kg/m ²	0.03941	0.003284	0.002896	0.073556
in water*	1.0	0.08333	0.073483	1.8665
ft. water*	12.0	1.0	0.88180	22.3980
in mercury**	13.608	1.1340	1.0	25.40005
mm mercury **	0.535764	0.044647	0.03937	1.0

*Water at 60.0 °F ** Mercury at 32.0 °F

Problem:

10 inches of water equals how many inches of mercury?

Solution:

1 inch of water is equal to 0.073483 inch mercury.
Then, 10 x 0.073483 = 0.73483 inch mercury.

Tons of water/24 hours 1.3349 Cu. ft./hr.

To convert from one set of units to another, locate the given unit in the left hand column, and multiply the numerical value by the factor shown horizontally to the right, under the set of units desired.

Appendix G

Useful Information

A gallon (U.S. Standard) of water contains 231 cubic inches and weighs 8.345 pounds (avoirdupois) at maximum density and at normal temperatures.

A gallon (British Imperial) of water contains 277.418 cubic inches and weighs 10.022 pounds (avoirdupois) at maximum density.

To find British Imperial gallons, multiply the U.S. gallons by 0.833.

To find U.S. gallons, multiply the British Imperial gallons by 1.201.

A cubic foot of water contains 7.482 gallons or approximately $7\frac{1}{2}$ gallons, 1728 cubic inches, and weighs 62.428 pounds (avoirdupois) at maximum density and at 39.2 degrees Fahrenheit.

The height of a column of water necessary to produce a pressure of one pound per square inch is 2.309 feet.

To find the pressure in pounds per square inch of a column of fresh water, multiply the height in feet by 0.433.

1,000,000 U. S. gallons per day - 695 U. S. gallons per minute.

Gallons per Minute (GPM)	{	$\frac{\text{Pounds per hour}}{500 \times \text{Specific gravity}}$	{	$\frac{\text{Pressure in Pounds Per Sq. In.} \times 2.31}{\text{Specific Gravity}}$
		$\frac{\text{Pounds per minute}}{8.33 \times \text{Specific gravity}}$		$\frac{1.13 \times \text{Inches of Mercury}}{\text{Specific Gravity}}$
		$0.069 \times \text{Boiler horsepower (approx.)}$		$\text{Pressure in Pounds Per Sq. In.} = \frac{\text{Head in Feet} \times \text{Sp. Gr.}}{2.31}$
		$\frac{\text{cubic feet per minute}}{7.5}$		
		$449 \times \text{Cubic feet per second}$		
		$0.0292 \times \text{Bbl. per day}$	{	$\frac{\text{GPM} \times \text{Head in Feet} \times \text{Sp. Gr.}}{3960 \times \text{Pump Efficiency}}$
	$0.7 \times \text{Bbl. per hour}$	$\frac{\text{GPM} \times \text{Pounds Per Sq. In.}}{1715 \times \text{Pump Efficiency}}$		
				$\frac{\text{Theoretical Horsepower}}{\text{Pump Efficiency}}$

One horsepower = 33,000 ft. pounds per minute

Cubic Feet per Second = GPM / 449

$$\text{Velocity in Feet per Second} = \frac{\text{U.S. GPM} \times .408}{(\text{Diameter of Pipe in Inches})^2} = \frac{\text{GPM} \times 0.32}{\text{Area of Pipe in Sq. Inches}}$$

$$\text{Velocity in Feet per Minute Necessary to Discharge a Given Volume of Water in a Given Time} = \frac{\text{Cu. Ft.} \times 144}{\text{Area of Pipe in Sq. Inches}}$$

$$\text{Area of Required Pipe, Volume and Velocity of Water Being Given} = \frac{\text{Cu. Ft.} \times 144}{\text{Vel. in Ft. Per Minute}}$$

$$\text{Velocity Head (or head due to velocity)} \quad H = \frac{V^2}{2G} \quad V = \sqrt{2GH}$$

G = Acceleration Due to Gravity or 32.16 Feet per Second per Second.

Appendix H

Tables and Rules

General Data – Weight and Measures

Linear Measure

12 inches (in)	=	1 foot	ft
3 feet	=	1 yard	yd
5.5 yards	=	1 rod	rd
10 rods	=	1 furlong	fur
8 furlongs	=	1 mile	mi

Square Measure

144 square inches (sq in)	=	1 square foot	sq ft
9 square feet	=	1 square yard	sq yd
30¼ square yards	=	1 square rod	sq rd
160 square rods	=	1 acre	A.
640 acres	=	1 square mile	sq mi

Cubic Measure

1.728 cubic inches	=	1 cubic foot	cu ft
27 cubic feet	=	1 cubic yard	cu yd
128 cubic feet	=	1 cord	cd
24½ cubic feet	=	1 perch	P

Measures of Angles or Area

60 seconds	=	1 minute	
60 minutes	=	1 degree	
90 degrees	=	1 rt. angle or quadrant	
360 degrees	=	1 circle	cir
360 degrees	=	2 pi radians	

Avoirdupois Weight

537.5 grains (gr)	=	1 ounce	oz
16 ounces	=	1 pound	lb
100 pounds	=	1 hundredweight	cwt
20 cwt., or 2,000 lbs.	=	1 ton	T

Long Ton Table

16 ounces	=	1 pound	lb
112 pounds	=	1 hundredweight	cwt
20 cwt., or 2,240 lbs.	=	1 ton	T

Troy Weight

24 grains (gr.)	=	1 pennyweight	
pwt.			
20 pennyweights	=	1 ounce	oz.
12 ounces	=	1 pound	lb.

Dry Measure

2 pints (pt.)	=	1 quart	qt.
8 quarts	=	1 peck	pk.
4 pecks	=	1 bushel	bu.

Liquid Measure

4 gills (gi.)	=	1 pint	pt
2 pints	=	1 quart	qt.
4 quarts	=	1 gallon	gal.
31½ gallons	=	1 barrel	bbl.
2 barrels, or 63 gallons	=	1 hogshead	hhd.
42 gallons	=	1 barrel	bbl.

1 hhd. = 2 bbl. = 63 gal. = 252 qt. = 504 pt. = 2,016 gi.

The U. S. gallon contains 231 cu. in. = .134 cu. ft. nearly; or 1 cu. ft. contains 7.480 gal. The following cylinders contain the given measures very closely.

	Diameter (in)	Height(in)
Gill	1¾	3
Pint	3½	3
Quart	3½	6
Gallon	7	14
8 gallons	14	12
10 gallons	14	15

With water at its maximum density (weighing 62.425 lb per cu ft), a gallon of pure water weighs 8.345 lbs.

For approximations, 1 cu ft of water is considered equal to 7½ gal, and 1 gal as weighing 8⅓ lbs.

Miscellaneous Table

12 articles	=	1 dozen
12 dozen	=	1 gross
12 gross	=	1 great gross
2 articles	=	1 pair
20 articles	=	1 score
24 sheets	=	1 quire
20 quires	=	1 ream
1 league	=	3 miles
1 fathom	=	6 feet
1 hand	=	4 inches
1 palm	=	3 inches
1 span	=	9 inches

Metric and English Measures

Measures of Length

Metric	English
1.0 meter	= 39.37 inches
1.0 meter	= 3.28 feet
0.3048 meter	= 1 foot
1.0 centimeter	= 0.3937 inch
2.54 centimeters	= 1.0 inch
1.0 millimeter	= 0.03937 inch (~1/25")
25.4 millimeters	= 1.0 inch
1.0 kilometer	= 1093.61 yards

Measures of Volume

Metric	English
1.0 cubic meter	= 35.314 cubic feet
0.02832 cubic meter	= 1.0 cubic feet
10. cubic decimeter	= 61.023 cubic inches
1.0 cubic decimeter	= 0.0353 cubic foot
28.32 cubic decimeter	= 1.0 cubic foot
16.387 cubic decimeter	= 1.0 cubic inch
1.0 cubic centimeter	= 0.061 cubic inch

Measures of Surface

Metric	English
1.0 square meter	= 10.764 square feet
0.0929 square meter	= 1 square foot
1.0 square centimeter	= 0.155 square inch
6.452 square centimeters	= 1.0 square inch
1.0 square millimeter	= 0.00155 square inch
645.2 square millimeters	= .0 square inch

Measures of Weight

Metric	English
28.35 grams	= 1.0 ounce avoirdupois
1.0 kilogram	= 2.2046 pounds
0.4536 kilogram	= 1.0 pound
1.0 metric ton (1000 kg)	= 0.9842 ton of 2240 lbs
1.0 metric ton (1000 kg)	= 19.68 cwt, or 2204.6 lbs
1016 kilograms	= 1 ton or 2240 pounds (1.016 metric tons)

Measures of Capacity

1 liter = 1 cubic decimeter	= 61.023 cubic inches
1 liter = 1 cubic decimeter	= 0.0353 cubic foot
1 liter = 1 cubic decimeter	= 0.2202 gallon - Imperial
1 liter = 1 cubic decimeter	= 2.202 pounds of water at 62.0 °F
28.317 liters	= 1 cubic foot (6.25 Imperial gallons)

4.543 liters	= 1 gallon - Imperial
3.785 liters	= 1 gallon - American

Miscellaneous

Metric	English
1.0 gram per square millimeter	= 1.422 Pounds per square inch
1.0 kilograms per square millimeter	= 1422.32 Pounds per square inch
1.0 kilogram per square centimeter	= 14.233 Pounds per square inch
1.0335 kilogram per square centimeter	= 14.7 Pounds per square inch
1.0 atmosphere	= 14.7 Pounds per square inch
0.070308 kilogram per square centimeter	= 1.0 Pound per square inch

Weight of One Cubic Foot of Pure Water

At 32.0 °F (freezing point)	62.418 lbs.
At 39.1 °F (maximum density)	62.425 lbs.
At 62.0 °F (standard temperature)	62.355 lbs.
At 212.0 °F (boiling point, under 1 atmosphere)	59.76 lbs.
Imperial gallon =	277.274 cubic inches
of water at 62.0 °F =	10 lbs.
American gallon =	231 cubic inches of water
at 62 °F =	8.3356 lbs.

General Data

1 Calorie	= 3.968 Btu
1 Btu	= 0.252 Calorie
1 lb per sq. in2	= 703.08 kilograms / m ²
1 Kilogram per m2	= .00142 lb per sq in
1 Calorie per m2	= .3687 Btu per sq ft
1 Btu per sq ft	= 2.712 calories per m ²
1 Calorie per m2 per degree difference Cent.	= .2048 Btu per sq ft per degree difference Fahr
1 Btu per sq ft. per degree difference Fahr.	= 4.882 Calories per m ² per degree difference Cent.
1 Btu per lb	= 0.556 Calorie per kilog.
1 Calorie per kilog	= 1.8 Btu per lb.
Water expands in bulk from 40 °F to 212 °F	= One twenty-third (approximately)

A cubic inch of water evaporated under ordinary atmospheric pressure is converted into 1 cubic foot of steam (approximately).

Metric and English Measures

Measure of Pressure and Weight

1 lb. per square inch	=	144 lbs. per square foot
1 lb. per square inch	=	2.0355 inches of mercury at 32.0 °F
1 lb. per square inch	=	2.0416 inches of mercury at 62.0 °F
1 lb. per square inch	=	2.309 ft. of water at 62.0 °F
1 lb. per square inch	=	27.71 inches of water at 62.0 °F
1 Atmosphere (14.7 lbs. per sq in.)	=	2116.3 lbs. per square foot
1 Atmosphere (14.7 lbs per sq in.)	=	33.947 ft. of water at 62.0 °F
1 Atmosphere (14.7 lbs per sq in.)	=	30 inches of mercury at 62.0 °F
1 Atmosphere (14.7 lbs per sq in.)	=	29.929 inches of mercury at 32.0 °F
1 Atmosphere (14.7 lbs per sq in.)	=	760 millimeters of mercury at 32.0 °F
1 Foot of Water at 62.0 °F	=	0.433 lb. per square inch
1 Foot of Water at 62.0 °F	=	62.355 lbs. per square foot
1 Inch of Mercury at 62.0 °F	=	491 lbs. or 7.86 oz. per sq. in.
1 Inch of Mercury at 62.0 °F	=	1.132 ft. of water at 62.0 °F
1 Inch of Mercury at 62.0 °F	=	13.58 inches of water at 62.0 °F

Appendix I

Bibliography

Chamber's Technical Dictionary
Edited by C.F. Tweney and L.E. C. Hughes
The MacMillan Co.
New York - 1949

Concise Chemical and Technical Dictionary
Editor: H. Bennett
Chemical Publishing Co., Inc.
New York - 1962

Construction Dictionary
Published by Greater Phoenix,
Arizona, Chapter #98
The National Association of Women
in Construction - 1973

New Mechanical Dictionary
Publisher: Theo Audel and Co.
New York - 1960

Dictionary of Plastics
J. A. Wordingham & P. Reboul
George Newnes Limited
London - 1965

Dictionary of Technical Terms
Frederick Swing Crispin
The Bruce Publishing Company
Milwaukee - 1964

Modern Science Dictionary
Compiled by A. Hechtlinger
Franklin Publishing Co., Inc.
New Jersey - 1959

A Glossary of Sanitary Engineering Terms
Isaac, P.S.G. - 1955

How to Design and Install Plumbing
Fourth Edition - 1960

Van Nostrand's Scientific Encyclopedia - 4th Edition
New Jersey - 1968

Dictionary of Civil Engineering
John S. Scott
Penguin Books - 1965

An Illustrated Dictionary of Plumbing Terms
Evan Berry
London Technical Press - 1960

Introductory Readings on Language
Wallace H. Anderson and Norman C. Stageberg
Hart, Rinehart, and Winston
New York - 1966
Pg. 133-149

The Machinist Dictionary
Fred Herbert Colvin
Simmons-Boardman Publishing Corp.
New York - 1956

State and Local Plumbing Codes

Webster's Third New International Dictionary
G.C. Merriman Co., Publishers
Springfield, Mass., U.S.A. - 1965

Dictionary of Water and Sewage Engineering
Meink, F. and Mohle, H.
Amsterdam - London
Elsener - 1963

National Plumbing Code (Illustrated)
Vincent T. Manas
Manas Publications
St. Petersburg, Florida - 1968

National Standard Plumbing Code
Publisher: National Association of Plumbing, Heating and Cooling Contractors - 1973
A. J. Matthias, Jr. and Estes Smith, Sr.
American Technical Society
Chicago, Illinois

Plumbers and Steamfitters Guide - Nos. 1, 2, 3, 4
Theo Audel and Company
New York - 1959, 1960

The Plumber's Companion
By James Hastings
Bristol Typesetting Co., Ltd.
Bristol, England - 1972

Manual of British Water Engineering Practice
Editor: Skeat, W. O. - 1961

A Practical Handbook of Water Supply
Dikey, F. - 2nd Edition
London, Murby - 1950

Public Health Engineering Abstracts
Robert A. Taft, Sanitary Engineering Center
U.S. Dept. of Health, Education & Welfare
c/o Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20025

Glossary: Water and Waste Water Control Engineering
Jointly prepared by an Editorial Board, representing: American Public Health Assn., American Society of Civil Engineers, American Waterworks Assn. The Water Pollution Control Federation - 1969

Water Supply Engineering
Babbitt, Harold E. and others
6th Edition
New York - 1962

Water Pollution Abstracts
Department of Scientific and Industrial Research
Water Pollution Research Laboratories
London, H. M.

A Glossary of Water and Sewage Terms
World Health Organization - 1956

The Technical and Engineering Data Book
Domestic Engineering Company
Chicago, Illinois - 1962

Uniform Plumbing Code
International Association of Plumbing and Mechanical Officials
1967 Edition

Semantics
Stephen Ullman
Basil Blackwell
Oxford - 1967

Year Books of American Society of Sanitary Engineering
Publisher: ASSE
Cleveland, Ohio

Plumbing
H. E. Babbitt - Third Edition
McGraw-Hill Book Company, Inc.
New York, Toronto, London - 1960

The Reader's Digest Great Encyclopedic Dictionary
Reader's Digest Association
Pleasantville, New York

Building Officials Conference of America
Homewood, Illinois

The Secretary's Desk Book
John C. Winston Co.

The American Heritage Dictionary
William Morris, Author
Published by American Heritage Publishing Co., Inc. and Houghlin Mifflin Co.
New York, New York

The Solar Home Book
by Bruce Anderson with
Michael Riddar

The ASHRAE Guide
Published by American Society of Heating, Refrigerating and Air Conditioning Engineers
New York, New York

New ASTM Standard Definition of Terms Relating to Solar Energy Conversion
American Society for Testing and Materials
Philadelphia, Pennsylvania - 1979

Appendix J

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Technical Consultant	Morris Weinberg <i>Plumbing Engineer</i> <i>Philadelphia, PA</i>
Technical Consultant	Dominic Soffietto <i>Secretary, Joint Apprentice and</i> <i>Training Committee</i> <i>Burbank, CA</i>
Technical Consultant	William Koenig <i>Past President, ASSE</i>
Lexicographer and Researcher	Amy L. Jacobson, B.A., M.A. <i>American University</i> <i>Washington, DC</i>
Cross References and Consulting	Amy Ruth Isaacs, B.S., M.S. in L.S. <i>School of Library Science</i> <i>Case Western Reserve University</i> <i>Cleveland, OH</i>
Librarian	George Macy <i>Former Chief Plumbing Inspector</i> <i>Cudahy, WI</i>
Critical Assistance	Frances Knerem <i>Madison, OH</i>
Associate Librarian	

Appendix K

Industry Associations and Government Agencies

ABPA	American Backflow Prevention Association www.abpa.org
AGA	American Gas Association www.aga.org
ANSI	American National Standards Institute www.ansi.org
ASCE	American Society of Civil Engineers www.asce.org
ASHRAE	American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. www.ashrae.org
ASME	American Society of Mechanical Engineers www.asme.org
ASPE	American Society of Plumbing Engineers www.aspe.org
ASSE	ASSE International www.asse-plumbing.org
ASTM	American Society for Testing and Materials www.astm.org
ASA	American Supply Association www.asa.net
AWWA	American Water Works Association www.awwa.org
AWS	American Welding Society www.aws.org
AHAM	Association of Home Appliance Manufacturers www.aham.org
CISPI	Cast Iron Soil Pipe Institute www.cispi.org
CDA	Copper Development Association, Inc. www.copper.org
CGA	Compressed Gas Association www.cganet.com
CSA	CSA International www.csa-international.org
EPA	Environmental Protection Agency www.epa.gov

FDA	Food & Drug Administration www.fda.gov
IAPMO	International Association of Plumbing & Mechanical Officials www.iapmo.org
ICC	International Code Council www.iccsafe.org
ISEA	International Safety Equipment Association www.safetysystem.org
ISH-NA	ISH-North America www.ish-na.com
MSS	Manufacturers Standardization Society www.mss-hq.com
MCAA	Mechanical Contractors Association of America, Inc. www.mcaa.org
NACE	National Association of Corrosion Engineers www.nace.org
NFPA	National Fire Protection Association www.nfpa.org
NFSA	National Fire Sprinkler Association www.nfsa.org
NIST	National Institute of Standards and Technology www.nist.gov
NITC	National Inspection, Testing and Certification www.nationalitc.com
NSF	NSF International www.nsf.org
PCA	Plumbing Contractors of America www.mcaa.org/pca
PDI	Plumbing & Drainage Institute www.pdionline.org
PHCC	Plumbing, Heating, Cooling Contractors www.phccweb.org
PMI	Plumbing Manufacturers Institute www.pmihome.org
PPFA	Plastic Pipe and Fittings Association www.ppfahome.org
PPI	Plastics Pipe Institute www.plasticpipe.org

UA	United Association of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry of the United States & Canada www.ua.org
UAC	Union Affiliated Contractors www.naphcc.org
UL	Underwriters Laboratory www.ul.com
USC-FCCC&HR	University of Southern California Foundation for Cross Connection Control & Hydraulic Research www.usc.edu/fccchr
WQA	Water Quality Association www.wqa.org
WPC	World Plumbing Council www.worldplumbing.org

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