

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
23 November 2006 (23.11.2006)

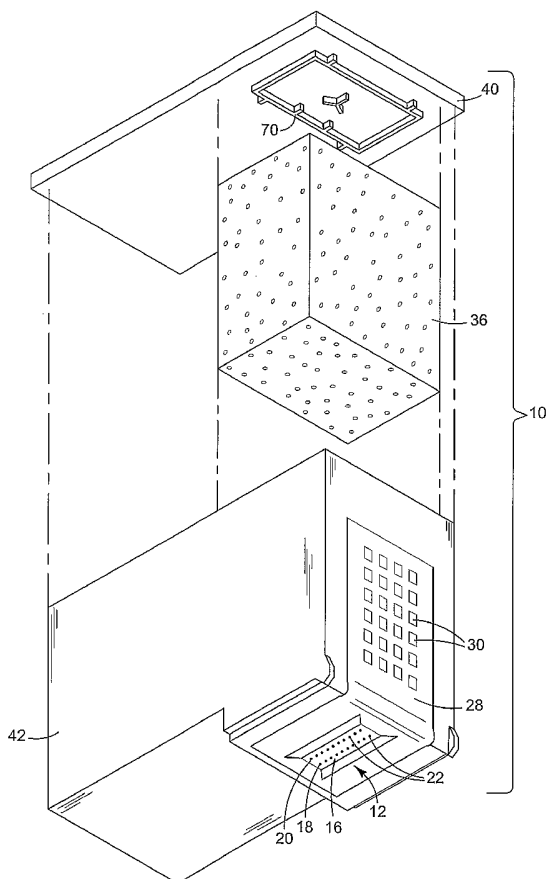
PCT

(10) International Publication Number
WO 2006/124331 A1

- (51) International Patent Classification:
B41J 2/175 (2006.01)
- (21) International Application Number:
PCT/US2006/017392
- (22) International Filing Date: 5 May 2006 (05.05.2006)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
11/132,921 19 May 2005 (19.05.2005) US
- (71) Applicant (for all designated States except US):
HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P. [US/US]; Hewlett-Packard Company, Intellectual Property Administration, 20555 S.H. 249, Houston, Texas 77070 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **RITTGERS, Jon** [US/IE]; Liffey Park Technology Campus, Barnhall Road, Leixlip IE (IE). **MARCIAS, Eduardo** [MX/IE]; Liffey Park Technology Campus, Barnhall Road, Leixlip IE (IE).
- (74) Agents: **JOLLY, Thomas A.** et al.; Hewlett-Packard Company, Intellectual Property Administration, P.o. Box 272400, Mail Stop 35, Fort Collins, Colorado 80527-2400 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT,

[Continued on next page]

(54) Title: INK SUPPLY



(57) Abstract: In one embodiment, a foam ink supply includes: a chamber (14) defined by a ceiling (40), a floor (56), and a wall (48, 50, 52 and/or 54) between the ceiling (40) and the floor (56); an outlet (44) from the chamber (14); and a block of foam (36) only partially filling the chamber (14), the block of foam (36) positioned adjacent to the outlet (44) and spaced apart from at least part of the wall (48, 50, 52 and/or 54).

WO 2006/124331 A1



RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INK SUPPLY

BACKGROUND

[0001] Ink cartridges used in inkjet printers include a printhead and one or more chambers that hold the ink. The printhead is a micro-electromechanical part that contains an array of miniature thermal resistors or piezoelectric transducers that are energized to eject small droplets of ink out of an associated array of orifices. The cartridge is mounted in a carriage in the printer and electrically connected to the printer controller. Under the direction of the controller, the cartridge is scanned back and forth across the print medium (usually paper) as resistors or transducers are energized to eject droplets of ink through the orifices on to the medium in the desired pattern.

[0002] In many conventional ink cartridges, each ink chamber is filled with a block of foam to hold the ink and to generate backpressure that helps regulate the flow of ink to the printhead. The ink-holding capacity of full blocks of foam that fill the ink chamber, however, is not always fully utilized. Full blocks of foam can also generate too much backpressure, stranding ink in the cartridge. The cost of the foam is a significant part of the overall cost of the ink cartridge.

DRAWINGS

[0003] Fig. 1 is a perspective view illustrating an ink cartridge according to an embodiment of the invention.

[0004] Figs. 2 and 3 are front and side elevation section views illustrating internal features of the ink cartridge of Fig. 1.

[0005] Figs. 4-6 are front and side elevation and plan section views, respectively, of the ink cartridge of Fig. 1 with the ink holding foam omitted to more clearly illustrate some of the internal features of the ink cartridge.

[0006] Fig. 7 is an elevation section view of the cartridge of Fig. 1 showing the printhead area of the cartridge.

[0007] Fig. 8 is a bottom plan view of the cartridge of Fig. 1 showing the ink ejection orifices.

[0008] Fig. 9 is a detail section view of a portion of the printhead in the cartridge of Fig. 1.

[0009] Fig. 10 is an elevation section view of the cartridge of Fig. 1 showing one example of a conventional feature that may be used to help retain a new smaller foam block.

[0010] Fig. 11 is a perspective view illustrating an ink cartridge according to another embodiment of the invention.

[0011] Figs. 12 and 13 are elevation section views illustrating an ink cartridge according to another embodiment of the invention.

[0012] Fig. 14 is an elevation section view illustrating an ink cartridge according to another embodiment of the invention.

DESCRIPTION

[0013] Embodiments of the present invention were developed in an effort to effectively utilize a reduced size foam block in a conventional ink cartridge -- reducing the size of the block of foam for holding ink in the ink chamber without changing the size or other characteristics of the molded plastic cartridge housing. Reducing the size of the block of foam helps in lowering the cost of the cartridge and, in some cases, reducing backpressure and allowing better utilization of the ink-holding capacity of the foam. An ink cartridge is also commonly referred to as an ink pen, a print cartridge or an inkjet print head assembly. The exemplary embodiments shown in the figures and described below illustrate but do not limit the invention. Other forms, details, and embodiments may be made and implemented. Hence, the following description should not be construed to limit the scope of the invention, which is defined in the claims that follow the description.

[0014] Figs. 1-9 illustrate an ink cartridge 10 for a thermal inkjet printer. Embodiments of the invention might also be implemented in an ink cartridge for a piezoelectric inkjet printer or any other inkjet printer in which it might be

desirable to use foam or another suitable ink holding material in the ink supply. Fig. 1 is a perspective view of cartridge 10. Figs. 2-6 are section views of ink cartridge 10. The ink holding foam is omitted from the section views of Figs. 4-6 to more clearly illustrate some of the internal features of ink cartridge 10. Fig. 7 is an elevation section view showing the printhead area of cartridge 10. Fig. 8 is a bottom plan view of cartridge 10 showing the ink ejection orifices. Fig. 9 is a detail section view of a portion of the printhead in cartridge 10.

[0015] Referring first to Figs. 1 and 7-9, cartridge 10 includes a printhead 12 located at the bottom of cartridge 10 below ink chamber 14. Printhead 12 includes an orifice plate 16 with two arrays 18, 20 of ink ejection orifices 22. In the embodiment shown, each array 18, 20 is a single row of orifices 22. As shown in the detail view of Fig. 9, firing resistors 24 formed on an integrated circuit chip 26 are positioned behind ink ejection orifices 22. A flexible circuit 28 carries electrical traces from external contact pads 30 to firing resistors 24.

[0016] When ink cartridge 10 is installed in a printer, cartridge 10 is electrically connected to the printer controller through contact pads 30. In operation, the printer controller selectively energizes firing resistors 24 through the signal traces in flexible circuit 28. When a firing resistor 24 is energized, ink in a vaporization chamber 32 (Fig. 9) next to a resistor 24 is vaporized, ejecting a droplet of ink through an orifice 22 on to the print media. The low pressure created by ejection of the ink droplet and cooling of chamber 32 then draws ink from an ink supply to refill vaporization chamber 32 in preparation for the next ejection. The flow of ink through printhead 12 is illustrated by arrows 34 in Fig. 9.

[0017] Referring now also to Figs. 2-6, ink is held in a foam block 36 in ink chamber 14 formed within a cartridge housing 38. Housing 38, which is typically molded plastic, may be molded as a single unit, molded as two parts (e.g., a lid 40 and a body 42) or constructed of any number of separate parts fastened to one another in the desired configuration. An outlet 44 to printhead 12 is located near the bottom of ink chamber 14. A filter 46 covering outlet 44 may be used to keep contaminants, air bubbles and ink flow surges from entering printhead 12. Ink is held in foam 36 or another suitable porous material to retain the ink at

an appropriate backpressure through capillary action. Foam 36 is usually compressed around filter 46 and outlet 44 to increase its capillarity in the region of outlet 44. As ink is depleted from foam 36, the increased capillarity near outlet 44 tends to draw ink from all other portions of foam 36 to maximize the amount of ink drawn from chamber 14.

[0018] In the embodiment shown in the figures, foam 36 does not fill chamber 14. This "partial-fill" foam configuration may be desirable, for example, to reduce the size of a conventional foam block without also changing the size or other characteristics of the molded plastic cartridge housing, such as housing 38. Although a single color cartridge 10 with only one ink chamber 14 is shown and described, embodiments of the invention are also applicable to tri-color and other multi-chambered cartridges in which a "partial-fill" foam configuration may be used in one or more of the multiple ink chambers. Referring now to Figs. 4-6, housing body 42 includes a front wall 48, side walls 50, 52, back wall 54 and a floor 56. Printhead 12 is positioned below outlet 44 in a depression 58 in a front part 60 of floor 56. Depression 58 is formed by a step 62 in floor 56. Filter 46 is affixed to the top of outlet 44 and contained by guides 64 that project up from floor front part 62 at depression 58. In the embodiment shown, outlet 44 projects a short distance into ink chamber 14 so that filter 46 is elevated above a rear part 66 of floor 56. An elevated filter 46 allows the compression of foam 36 around filter 46 to increase the capillarity of foam 36 in the region of outlet 44.

[0019] Ribs 68 and posts 69 are formed across floor 56 at step 62. Ribs 68 help wick ink from the area between posts 69 and from floor 56. Posts 69 are ejector pins used in the fabrication of conventional inkjet cartridge housings to remove the housing body from the mold. Foam block 36 is sized and shaped to fit tightly within a space bounded by ejector pin posts 68, front wall 48, sidewalls 50, 52, lid/ceiling 40 and filter 46. Fig. 10 is a detailed view showing foam 36 compressed behind ejector pin posts 68 to create added friction that helps retain foam 36 behind posts 68. The added friction created by a rough surface texture 70 on the bottom on ceiling 40 also helps retain foam 36. Wicking ribs 68 and ejector pin posts 69 illustrate one example of an existing feature that

may be used to help retain a new smaller foam block 36 in an otherwise conventional inkjet cartridge 10. In the embodiment shown in Figs. 2-3 and 10, foam block 36 is held in place by a combination of factors and structural features -- foam 36 is tucked behind posts 69, covers ribs 68, and presses against front wall 48, sidewalls 50, 52, ceiling 40, ribs 68 and posts 69.

[0020] Other configurations are possible. For example, in the embodiment shown in Fig. 11, ejector pin posts are omitted or ignored and rough surface texture 70 on ceiling 40 or on the inside of walls 48, 50 and 52 (not shown), or both, retains foam 36 compressed between lid 40 and filter 46. In the embodiment shown in Figs. 12 and 13, a shorter foam block 72 is retained on just two sides, compressed between spikes 74 protruding from sidewalls 50 and 52. In the embodiment shown in Fig. 14, step 62 in floor 56 is extended to help retain foam 36. A combination of pressure/compression and surface features (steps, bumps, posts, spikes and textures, for example) are used in the various embodiments to retain the foam. The less the walls are involved in holding the foam in place, the more the floor and lid/ceiling will be involved in holding the foam in place, and vice versa.

[0021] As noted at the beginning of this Description, the exemplary embodiments shown in the figures and described above illustrate but do not limit the invention. Other forms, details, and embodiments may be made and implemented. Therefore, the foregoing description should not be construed to limit the scope of the invention, which is defined in the following claims.

CLAIMS

1 1. A foam ink supply, comprising:
2 a chamber (14) defined by a ceiling (40), a floor (56), and a wall (48, 50,
3 52 and/or 54) between the ceiling (40) and the floor (56);
4 an outlet (44) from the chamber (14); and
5 a block of foam (36) only partially filling the chamber (14), the block of
6 foam (36) positioned adjacent to the outlet (44) and spaced apart from at least
7 part of the wall (48, 50, 52 and/or 54).

1 2. The ink supply of Claim 1, wherein:
2 the chamber (14) comprises a generally rectangular chamber (14) and
3 the wall (48, 50, 52 and/or 54) comprises a front wall (48), a back wall (54) and
4 sidewalls (50, 52); and
5 the block of foam (36) is spaced apart from the back wall (54) such that
6 no part of the block of foam (36) contacts the back wall (54).

1 3. The ink supply of Claim 1, wherein:
2 the chamber (14) comprises a generally rectangular chamber (14) and
3 the wall (48, 50, 52 and/or 54) comprises a front wall (48), a back wall (54) and
4 sidewalls (50, 52); and
5 the block of foam (36) is spaced apart from the front wall (48) and the
6 back wall (54) such that no part of the block of foam (36) contacts the front wall
7 (48) or the back wall (54).

1 4. The ink supply of Claim 1, wherein:
2 the chamber (14) comprises a generally rectangular chamber (14) and
3 the wall (48, 50, 52 and/or 54) comprises a front wall (48), a back wall (54) and
4 sidewalls (50, 52); and
5 the block of foam (36) is spaced apart from the ceiling (40), the front wall
6 (48) and the back wall (54) such that no part of the block of foam (36) contacts
7 the ceiling (40), the front wall (48) or the back wall (54).

1 5. The ink supply of Claim 1, further comprising ink held in the block
2 of foam (36).

1 6. The ink supply of Claim 1, further comprising a filter (46) between
2 the ink holding material (36) and the outlet (44).

3

1 7. A foam ink supply, comprising:
2 a chamber (14);
3 an outlet (44) from the chamber (14); and
4 a block of foam (36) positioned adjacent to the outlet (44) and only
5 partially filling the chamber (14) such that at least one side of the block of foam
6 (36) is substantially free of contact with any structural feature.

1 8. The ink supply of Claim 7, wherein the block of foam (36) is
2 pressed against the outlet (44).

1 9. The ink supply of Claim 7, further comprising a filter (46) covering
2 the outlet (44) and wherein the block of foam (36) is pressed against the filter
3 (46).

1 10. The ink supply of Claim 7, further comprising ink held in the block
2 of foam (36).

3

1 11. A foam ink supply, comprising:
2 a housing (38) having a chamber (14) therein;
3 an outlet (44) from the chamber (14);
4 a short retainer (62, 68 and/or 69) protruding from the housing (38) into a
5 bottom of the chamber (14) adjacent to the outlet (44); and
6 a block of foam (36) positioned adjacent to the outlet (44) and only
7 partially filling the chamber (14) such that only a bottom part of the foam block
8 (36) presses against the retainer (62, 68 and/or 69).

1 12. The ink supply of Claim 11, wherein the retainer (62, 68 and/or 69)
2 comprises posts (69) protruding from a floor (56) of the housing (38).

1 13. The ink supply of Claim 11, wherein the retainer (62, 68 and/or 69)
2 comprises a series of ribs (68) protruding from a floor (56) of the housing (38).

1 14. The ink supply of Claim 11, wherein the retainer (62, 68 and/or 69)
2 comprises a step (62) in a floor (56) of the housing (38).

1 15. An ink cartridge for inkjet printing, comprising:
2 a housing (38) having a chamber (14) therein defined by a ceiling (40), a
3 floor (56), and a wall (48, 50, 52 and/or 54) between the ceiling (40) and the
4 floor (56);
5 an outlet (44) from the chamber (14);
6 a printhead (12) affixed to the housing (38), the printhead (12) operatively
7 connected to the chamber (14) through the outlet (44); and
8 ink holding material (36) only partially filling the chamber (14), the ink
9 holding material (36) positioned adjacent to the outlet (44) and spaced apart
10 from at least part of the wall (48, 50, 52 and/or 54).

1 16. The ink cartridge of Claim 15, further comprising a filter (46)
2 covering the outlet (44) and wherein the ink holding material (36) is compressed
3 between the ceiling (40) and the filter (46).

1 17. The ink cartridge of Claim 15, further comprising a filter (46)
2 covering the outlet (44) and a rough surface texture (70) on the ceiling (40) and
3 wherein the ink holding material (36) is compressed between the ceiling (40)
4 and the filter (46).

1 18. The ink cartridge of Claim 15, wherein the ink holding material (36)
2 comprises foam (36).

1 19. The ink cartridge of Claim 15, wherein the ink holding material (36)
2 comprises a block of foam (36).

1 20. The ink cartridge of Claim 15, further comprising ink held in the
2 block of foam (36).

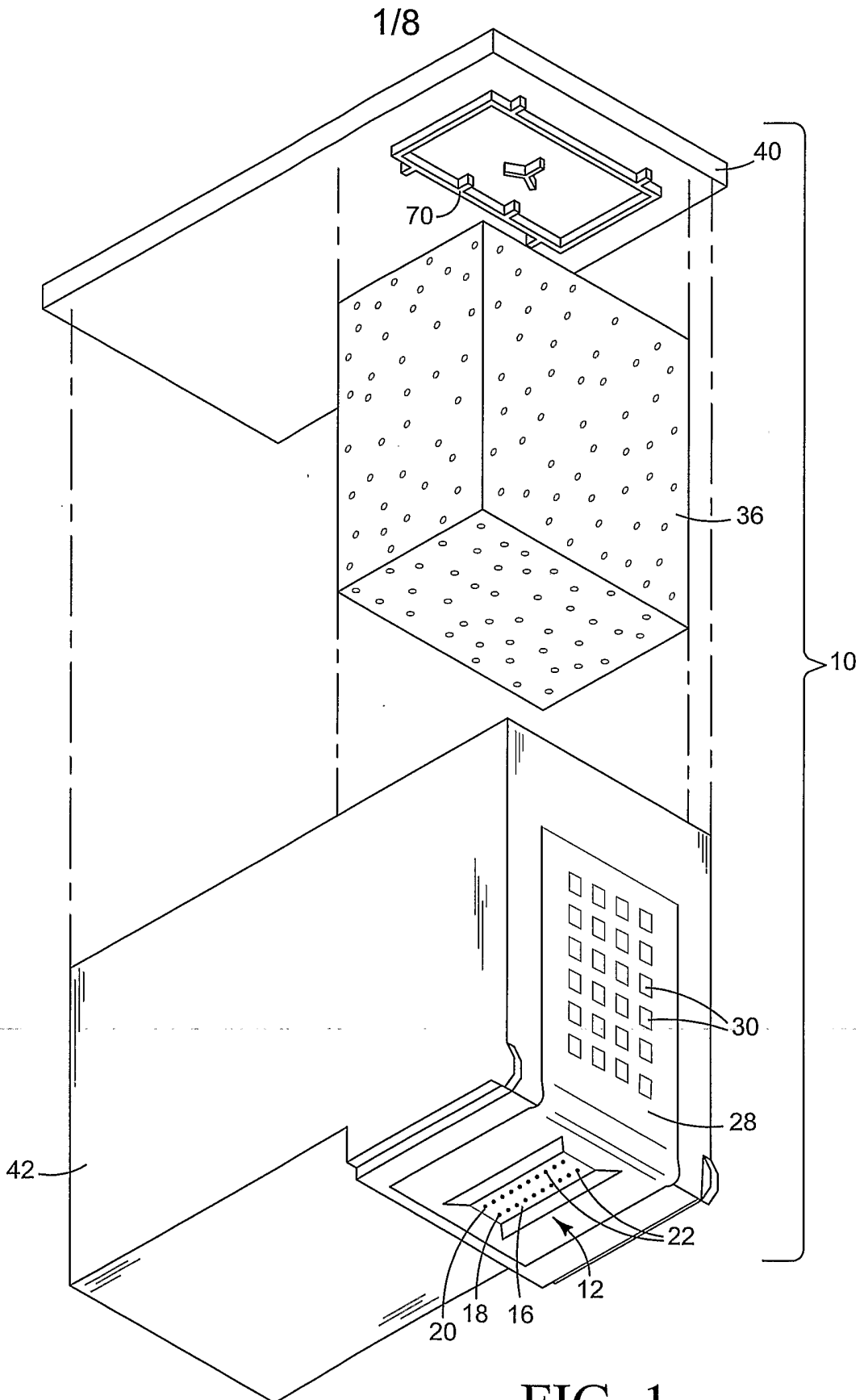


FIG. 1

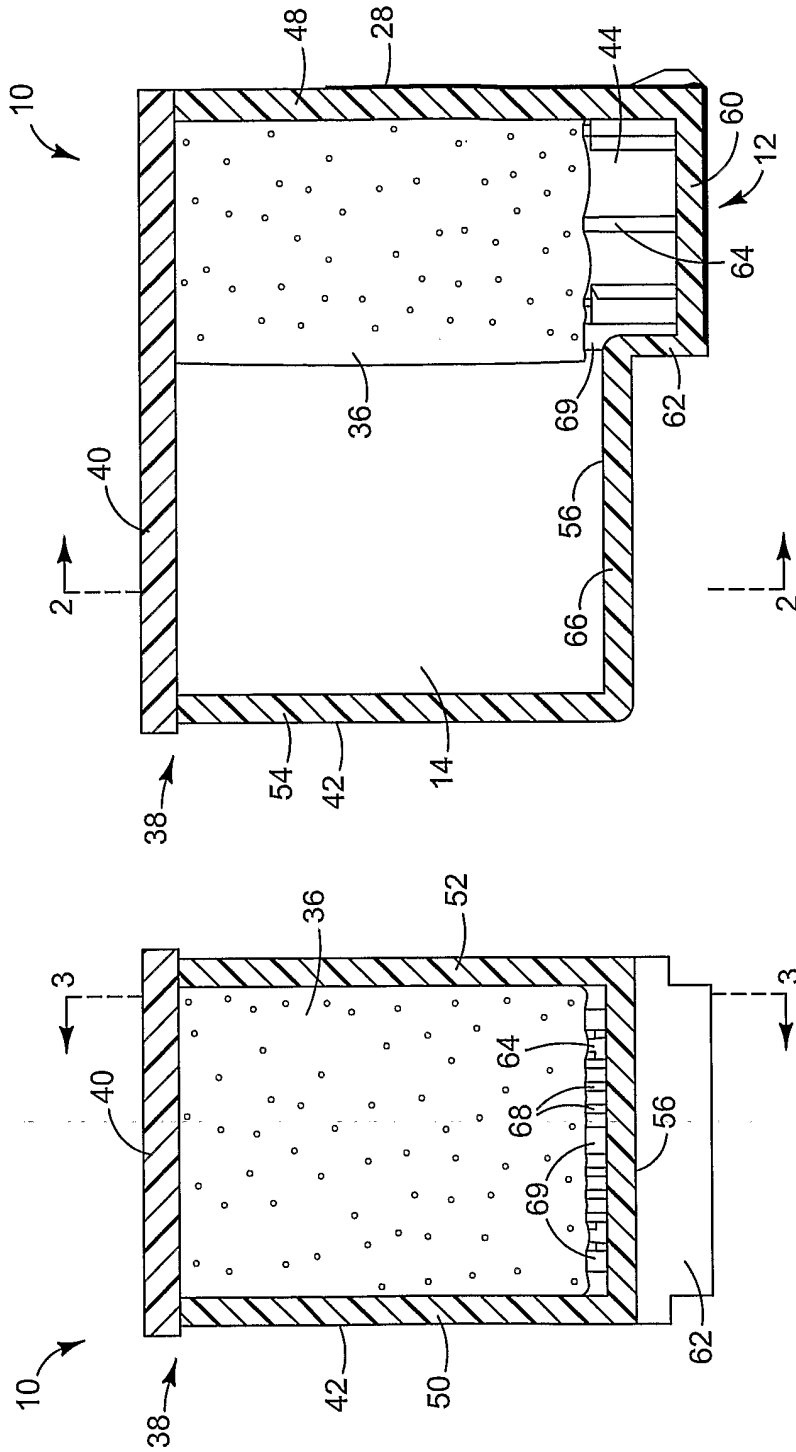


FIG. 3

FIG. 2

3/8

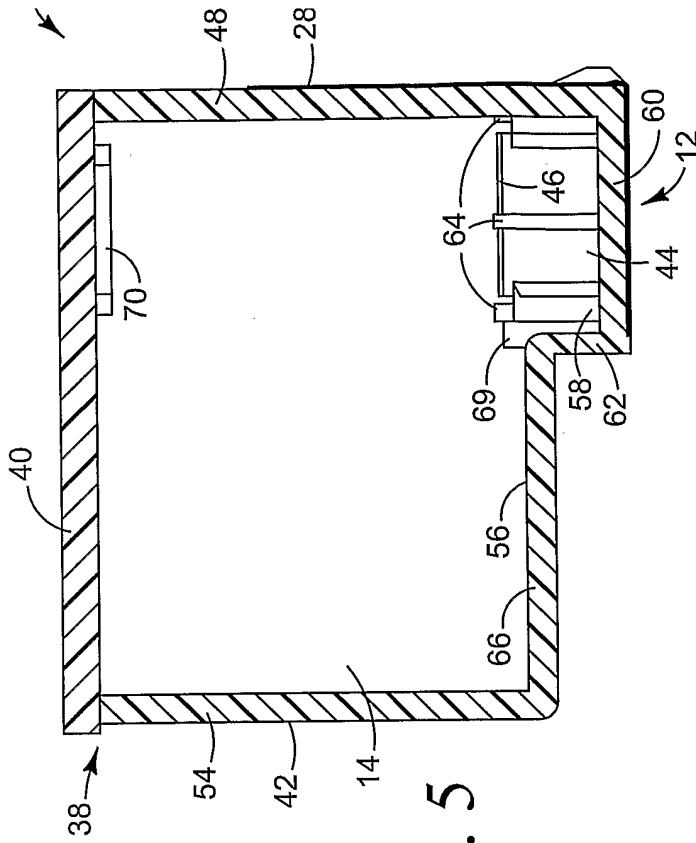


FIG. 5

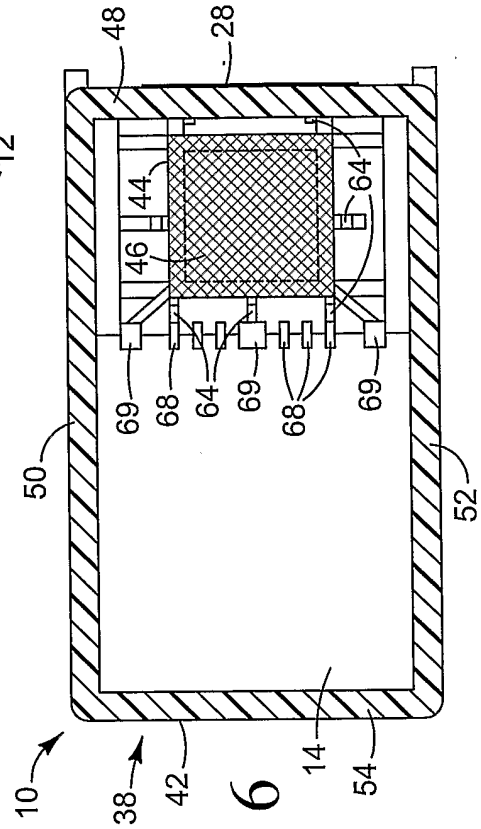


FIG. 6

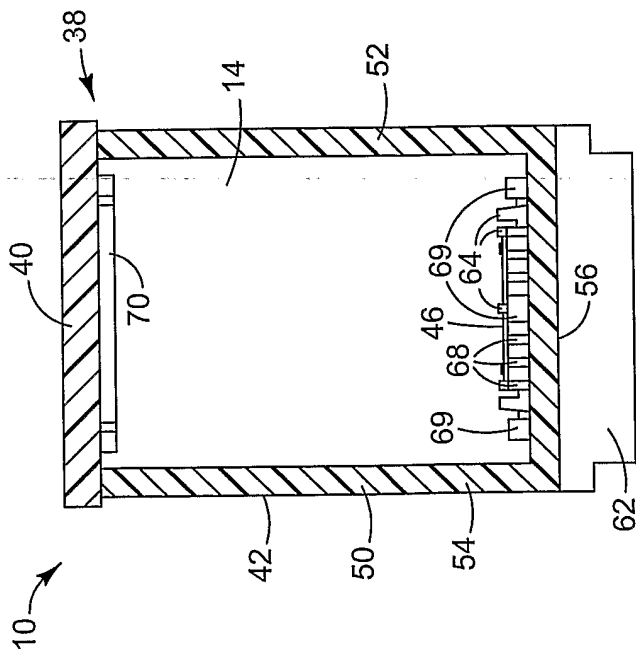


FIG. 4

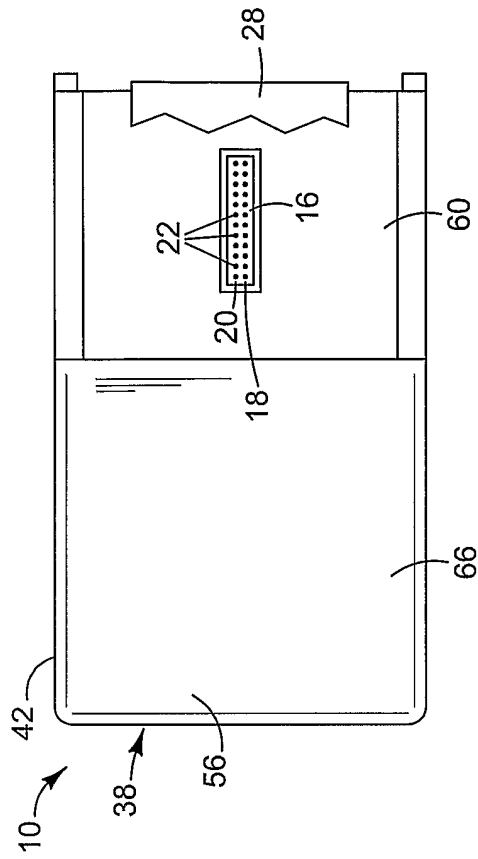


FIG. 8

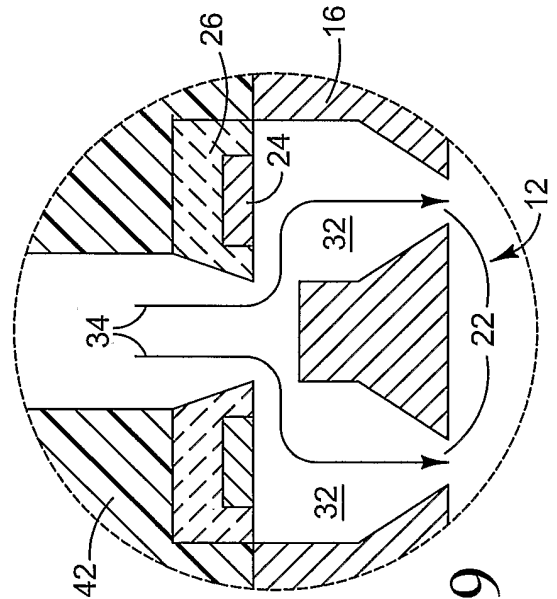


FIG. 9

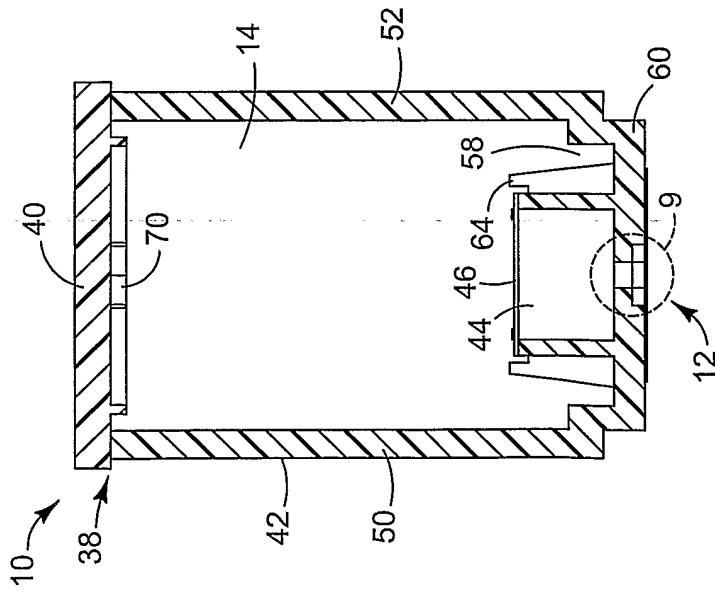


FIG. 7

5/8

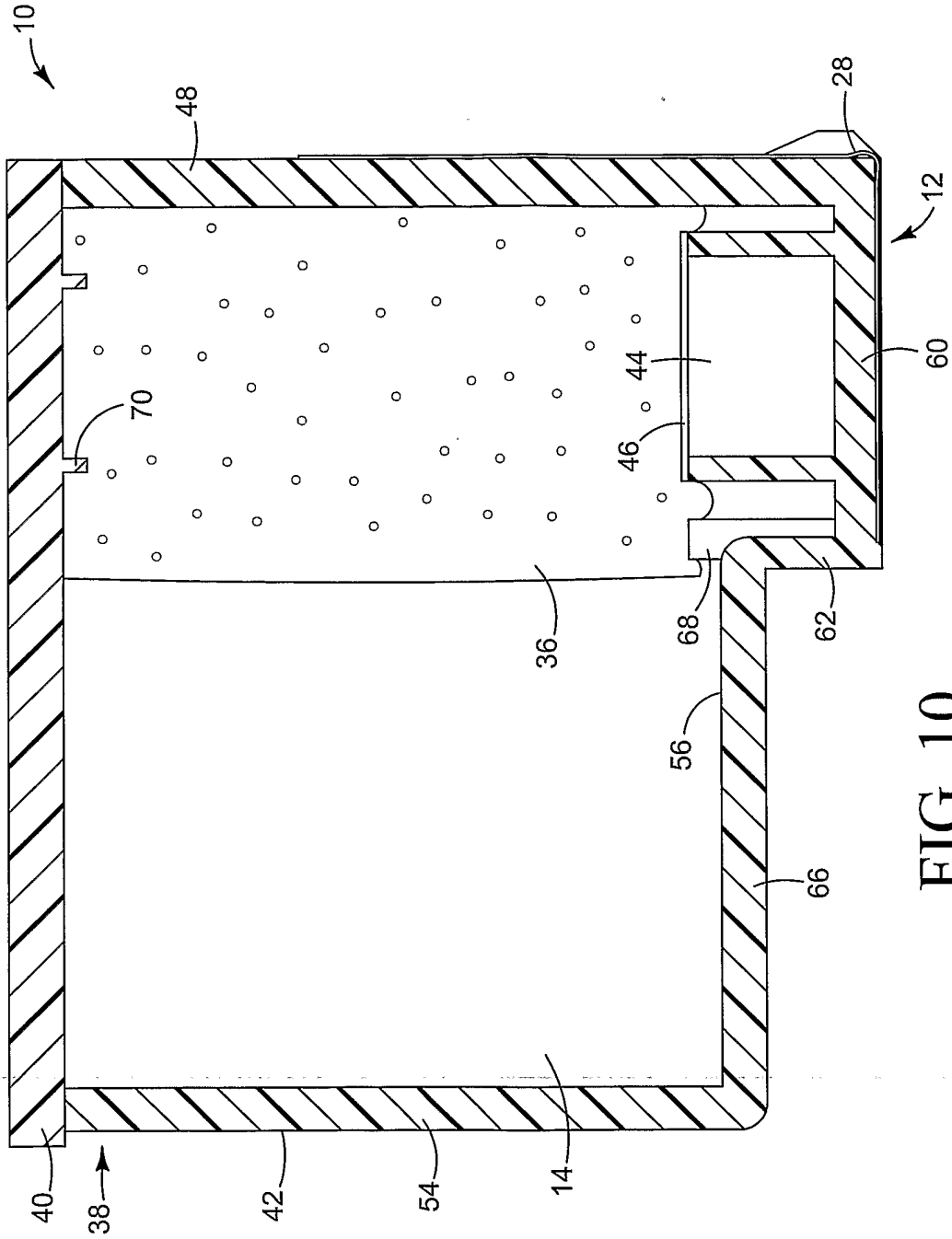


FIG. 10

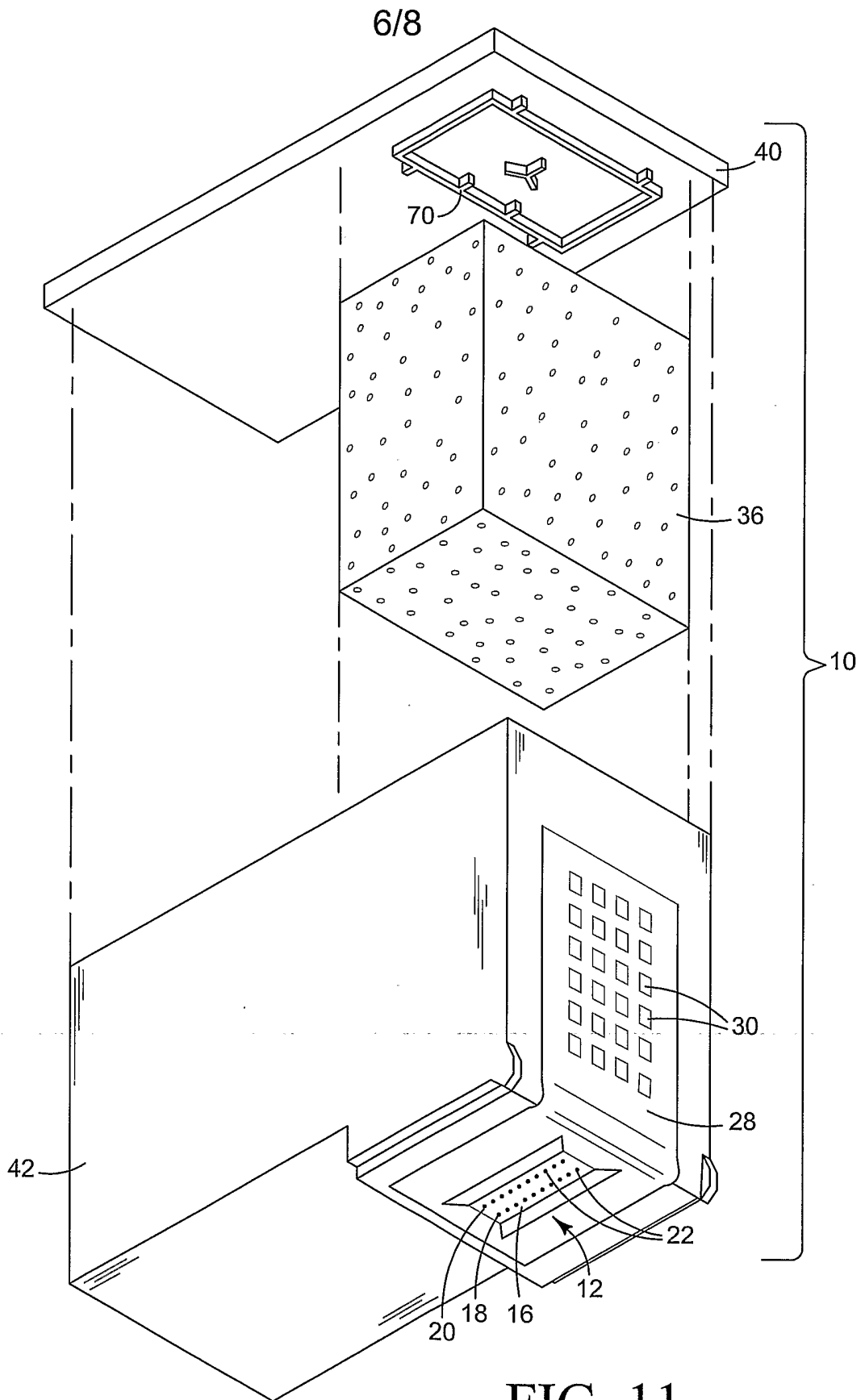


FIG. 11

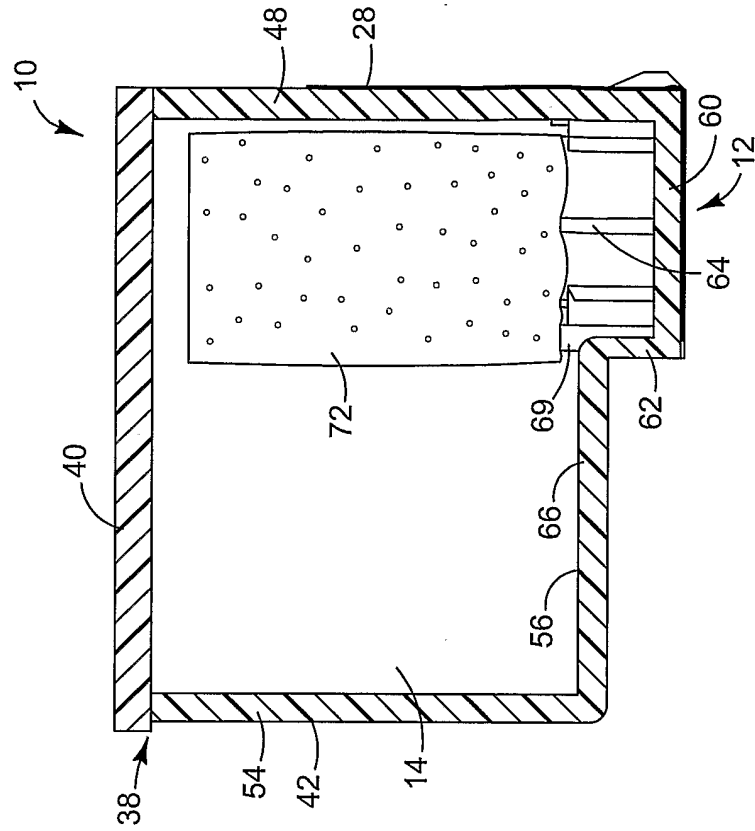


FIG. 13

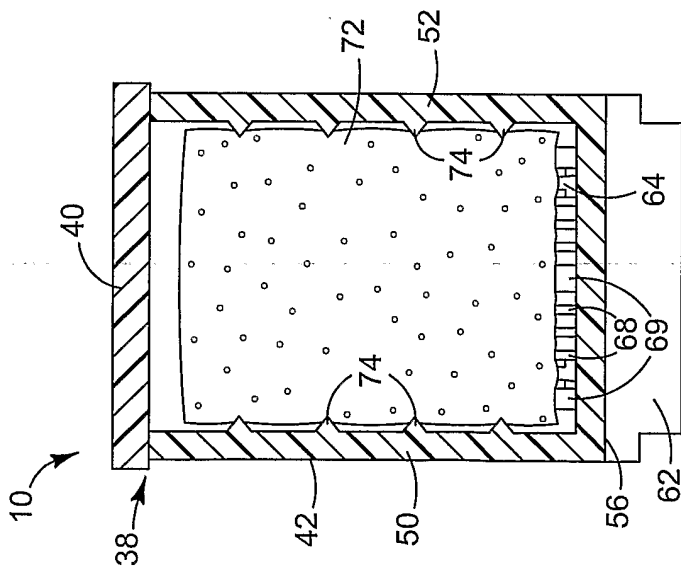


FIG. 12

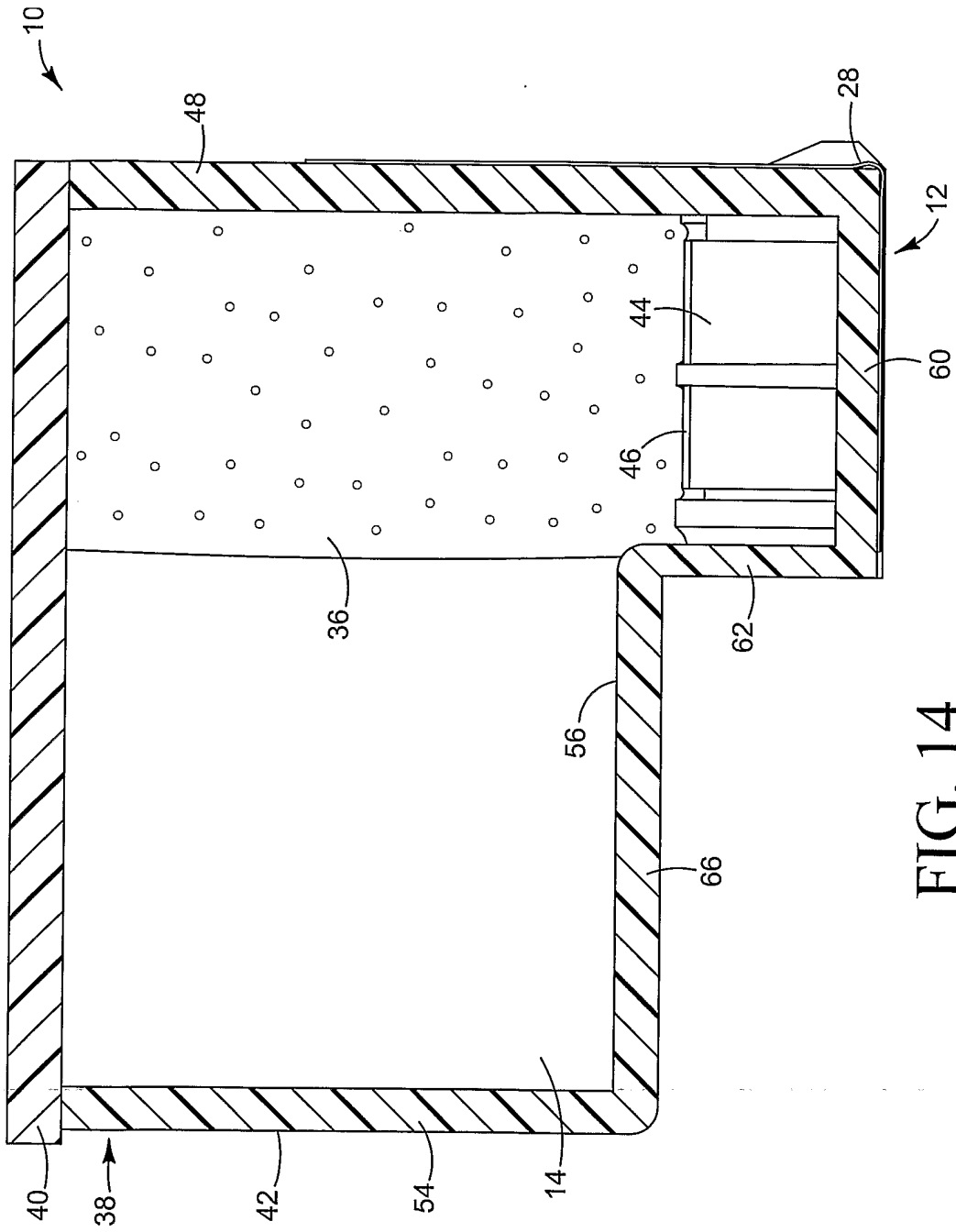


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/017392

A. CLASSIFICATION OF SUBJECT MATTER INV. B41J2/175		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B41J		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 095 643 A (COOK ET AL) 1 August 2000 (2000-08-01) column 3, line 31 - line 37 column 6, line 5 - line 7 column 1, line 6 - line 13	1-20
A	US 2004/201655 A1 (MIYAZAWA HISASHI ET AL) 14 October 2004 (2004-10-14) paragraph [0095]	7-10
A	US 2004/080591 A1 (CHO SCO-HYUN ET AL) 29 April 2004 (2004-04-29) paragraph [0036] - paragraph [0038]	1-20
A	EP 0 577 439 A (CITIZEN WATCH CO. LTD) 5 January 1994 (1994-01-05) column 2, line 48 - line 56	1-20
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents :		
A document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *&* document member of the same patent family	
Date of the actual completion of the international search	Date of mailing of the international search report	
15 September 2006	29/09/2006	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Gavaza, Bogdan	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2006/017392

Patent document cited in search report	Publication date	Publication date	Patent family member(s)	Publication date
US 6095643	A	01-08-2000	AU 4182999 A WO 9956960 A1	23-11-1999 11-11-1999
US 2004201655	A1	14-10-2004	US 2006139424 A1	29-06-2006
US 2004080591	A1	29-04-2004	JP 2004142463 A	20-05-2004
EP 0577439	A	05-01-1994	DE 69305430 D1 DE 69305430 T2 US 5453771 A	21-11-1996 13-02-1997 26-09-1995