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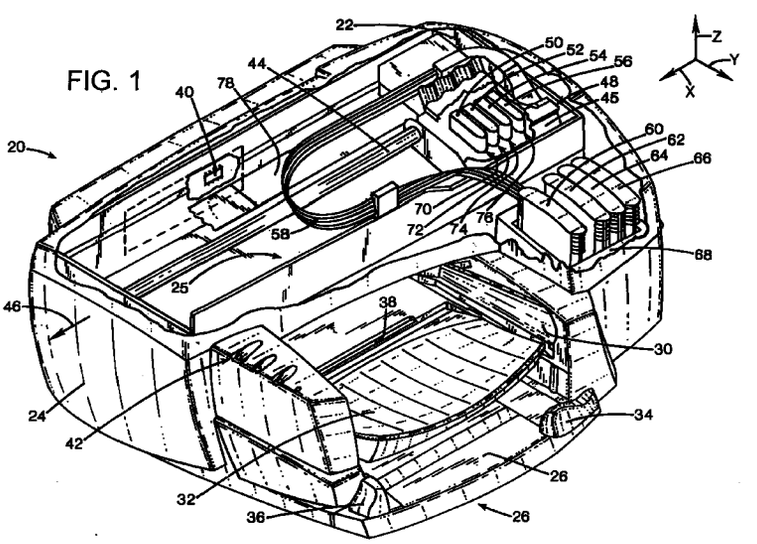
(54) Ink solvent dispenser system for inkjet printheads

(57) An ink solvent dispenser system (100; 120) is provided for cleaning a printhead (70, 72, 74, 76) in an inkjet printing mechanism (20). The dispenser (100; 120) has an enclosure shell (102; 122) defining a reservoir (104; 124) filled with an ink solvent (110), such as polyethylene glycol ("PEG"). A back-pressure device (105; 125), such as a porous body (106) or a spring-bag structure (126, 128), is located inside the reservoir (104; 124) to prevent ink solvent leakage. The dispenser (100; 120) has a sintered, high density polyethylene plastic applicator (108; 135) in fluid communication with the ink solvent (110) stored within the reservoir (104; 124) in a space-efficient manner. The applicator (108; 135) uses capillary forces to extract the ink solvent (110) from the reservoir (104; 124) for application to a printhead wiper (90, 92, 94, 96) contacting the applicator (108; 135). The wiper (90, 92, 94, 96) wipes across the printhead (70, 72, 74, 76), after which ink residue (112) is scraped (114) from the wiper (90, 92, 94, 96) prior to receiving the next dose of solvent (110). A method is also provided of dispensing ink solvent (110), along with an inkjet printing mechanism (20) having provisions for replaceably receiving the ink solvent dispenser system (100; 120).

FIG. 1



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Description

Field of the Invention

[0001] The present invention relates generally to inkjet printing mechanisms, and more particularly to an ink solvent dispenser system that stores and dispenses a inkjet ink solvent that is used in conjunction with a wiper system for cleaning inkjet printheads.

Background of the Invention

[0002] Inkjet printing mechanisms use cartridges, often called "pens," which eject drops of liquid colorant, referred to generally herein as "ink," onto a page. Each pen has a printhead formed with very small nozzles through which the ink drops are fired. To print an image, the printhead is propelled back and forth across the page, ejecting drops of ink in a desired pattern as it moves. The particular ink ejection mechanism within the printhead may take on a variety of different forms known to those skilled in the art, such as those using piezoelectric or thermal printhead technology. For instance, two earlier thermal ink ejection mechanisms are shown in U.S. Patent Nos. 5,278,584 and 4,683,481. In a thermal system, a barrier layer containing ink channels and vaporization chambers is located between a nozzle orifice plate and a substrate layer. This substrate layer typically contains linear arrays of heater elements, such as resistors, which are energized to heat ink within the vaporization chambers. Upon heating, an ink droplet is ejected from a nozzle associated with the energized resistor. By selectively energizing the resistors as the printhead moves across the page, the ink is expelled in a pattern on the print media to form a desired image (e.g., picture, chart or text).

[0003] To clean and protect the printhead, typically a "service station" mechanism is supported by the printer chassis so the printhead can be moved over the station for maintenance. For storage, or during non-printing periods, the service stations usually include a capping system which substantially seals the printhead nozzles from contaminants and drying. Some caps are also designed to facilitate priming, such as by being connected to a pumping unit that draws a vacuum on the printhead. During operation, clogs in the printhead are periodically cleared by firing a number of drops of ink through each of the nodes in a process known as "spitting," with the waste ink being collected in a "spittoon" reservoir portion of the service station. After spitting, uncapping, or occasionally during printing, most service stations have a elastomeric wiper that wipes the printhead surface to remove ink residue, as well as any paper dust or other debris that has collected on the printhead. The wiping action is usually achieved through relative motion of the printhead and wiper, for instance by moving the printhead across the wiper, by moving the wiper across the printhead, or by moving both the printhead and the wiper.

[0004] To improve the clarity and contrast of the printed image, recent research has focused on improving the ink itself. To provide quicker, more waterfast printing with darker blacks and more vivid colors, pigment-based inks have been developed. These pigment-based inks have a higher solid content than the earlier dye-based inks, which results in a higher optical density for the new inks. Both types of ink dry quickly, which allows inkjet printing mechanisms to form high quality images on readily available and economical plain paper, as well as on recently developed specialty coated papers, transparencies, fabric and other media.

[0005] As the inkjet industry investigates new printhead designs, the tendency is toward using permanent or semi-permanent printheads in what is known in the industry as an "off-axis" printer. In an off-axis system, the printheads carry only a small ink supply across the printzone, with this supply being replenished through tubing that delivers ink from an "off-axis" stationary reservoir placed at a remote stationary location within the printer. Since these permanent or semi-permanent printheads carry only a small ink supply, they may be physically more narrow than their predecessors, the replaceable cartridges. Narrower printheads lead to a narrower printing mechanism, which has a smaller "footprint," so less desktop space is needed to house the printing mechanism during use. Narrower printheads are usually smaller and lighter, so smaller carriages, bearings, and drive motors may be used, leading to a more economical printing unit for consumers.

[0006] There are a variety of advantages associated with these off-axis printing systems, but the permanent or semi-permanent nature of the printheads requires special considerations for servicing, particularly when wiping ink residue from the printheads, which must be done without any appreciable wear that could decrease printhead life. To accomplish this objective, use of an ink solvent has been proposed. In this proposed system, the ink solvent, a polyethylene glycol ("PEG") compound is stored in a reservoir, with the porous reservoir block having an applicator portion. An elastomeric wiper moves across the wetted porous applicator to collect PEG, which is then wiped across the printhead to dissolve accumulated ink residue. The wiper then moves across a rigid plastic scraper to remove any dissolved ink residue and dirtied PEG from the wiper before beginning the next wiping stroke. The PEG fluid also acts as a lubricant, so the rubbing action of the wiper does not unnecessarily wear the printhead. Furthermore, the PEG fluid also acts as a non-stick coating, which when applied to the printhead functions to repel ink accumulation.

[0007] Unfortunately, this proposed ink solvent system is subject to leaking PEG, particularly if the printer unit is turned on its side or upside down, which could easily occur during transportation, such as when moving one's

office or home to a new location. Moreover, the PEG does not move quickly to the applicator, so during a series of rapid wiping strokes, the wipers may not receive a adequate coating of PEG. Additionally, over the lifetime of the printer, the PEG ink solvent may need to be replenished to maintain optimum printhead servicing, and refilling the PEG reservoir is not easily accomplished with the proposed system.

Summary of the Invention

[0008] According to one aspect of the present invention, an ink solvent dispenser system is provided for cleaning an inkjet printhead in an inkjet printing mechanism having a printhead wiper. The system includes an enclosure shell defining a reservoir therein, with an ink solvent stored in the reservoir. The system also has a back-pressure device for retaining the ink solvent within the reservoir before application. The system has an applicator in fluid communication with the ink solvent stored within the reservoir, with the applicator supplying ink solvent to the printhead wiper through contact of the wiper with the applicator.

[0009] According to yet another aspect of the present invention, a method is provided for cleaning a inkjet printhead in an inkjet printing mechanism having a printhead wiper, with the method including the step of storing a supply of an ink solvent within a reservoir enclosure. In a preventing step, leakage of the ink solvent from the reservoir enclosure is prevented by maintaining a back-pressure within the reservoir enclosure. In a supplying step, the ink solvent is supplied to the printhead wiper through an applicator that is in fluid communication with the ink solvent stored within the reservoir enclosure. In an extracting step, the ink solvent is extracted from the reservoir enclosure and through the applicator through the use of capillary forces supplied by the applicator.

[0010] According to a further aspect of the present invention, an inkjet printing mechanism may be provided with an ink solvent dispenser system as described above.

[0011] An overall goal of the present invention is to provide an inkjet printing mechanism which prints sharp vivid images over the life of the printhead and the printing mechanism, particularly when using fast drying pigment or dye-based inks, and preferably when dispensed from an off-axis system.

[0012] Another goal of the present invention is to provide an ink solvent dispenser system for clearing printheads in an inkjet printing mechanism.

[0013] Still another goal of the present invention is to provide an ink solvent dispenser system for clearing printheads in an inkjet printing mechanism, with the system being easily replenished during the life of the printing unit to provide consumers with a reliable, robust inkjet printing unit.

Brief Description of the Drawings

[0014]

FIG. 1 is a perspective view of one form of an inkjet printing mechanism, here, an inkjet printer, including a printhead service station of the present invention for servicing inkjet printheads.

FIG. 2 is a side elevational view of the service station of FIG. 1, shown servicing an inkjet printhead, with the service station including one form of an ink solvent dispenser system of the present invention for clearing an inkjet printhead.

FIG. 3 is an enlarged perspective view of one form of the ink solvent dispenser portion of FIG. 2.

FIG. 4 is a fragmented side elevational view of another form of the ink solvent dispenser portion of FIG. 2.

FIG. 5 is a rear sectional view of the ink solvent dispenser of FIG. 3, taken along lines 5-5 of FIG. 4.

Detailed Description of a Preferred Embodiment

[0015] FIG. 1 illustrates an embodiment of an inkjet printing mechanism, here shown as an "off-axis" inkjet printer 20, constructed in accordance with the present invention, which may be used for printing for business reports, correspondence, desktop publishing, and the like, in an industrial, office, home or other environment. A variety of inkjet printing mechanisms are commercially available. For instance, some of the printing mechanisms that may embody the present invention include plotters, portable printing units, copiers, cameras, video printers, and facsimile machines, to name a few, as well as various combination devices, such as a combination facsimile/printer. For convenience the concepts of the present invention are illustrated in the environment of an inkjet printer 20.

[0016] While it is apparent that the printer components may vary from model to model, the typical inkjet printer 20 includes a frame or chassis 22 surrounded by a housing, casing or enclosure 24, typically of a plastic material. Sheets of print media are fed through a printzone 25 by a media handling system 26. The print media may be any type of suitable sheet material, such as paper, card-stock, transparencies, photographic paper, fabric, mylar, and the like, but for convenience, the illustrated embodiment is described using paper as the print medium. The media handling system 26 has a feed tray 28 for storing sheets of paper before printing. A series of conventional paper drive rollers driven by a stepper motor and drive gear assembly (not shown), may be used to move the print media from the input supply tray 28, through the printzone 25, and after printing, onto a pair of extended output drying wing members 30, shown in a retracted or rest position in FIG. 1. The wings 30 momentarily hold a newly printed sheet above any previously printed sheets still drying in a output tray

portion 32, then the wings 30 retract to the sides to drop the newly printed sheet into the output tray 32. The media handling system 26 may include a series of adjustment mechanisms for accommodating different sizes of print media, including letter, legal, A-4, envelopes, etc., such as a sliding length adjustment lever 34, a sliding width adjustment lever 36, and an envelope feed port 38.

[0017] The printer 20 also has a printer controller, illustrated schematically as a microprocessor 40, that receives instructions from a host device, typically a computer, such as a personal computer (not shown). The printer controller 40 may also operate in response to user inputs provided through a key pad 42 located on the exterior of the casing 24. A monitor coupled to the computer host may be used to display visual information to an operator, such as the printer status or a particular program being run on the host computer. Personal computers, their input devices, such as a keyboard and/or a mouse device, and monitors are all well known to those skilled in the art.

[0018] A carriage guide rod 44 is supported by the chassis 22 to slideably support an off-axis inkjet pen carriage system 45 for travel back and forth across the printzone 25 along a scanning axis 46. The carriage 45 is also propelled along guide rod 44 into a servicing region, as indicated generally by arrow 48, located within the interior of the housing 24. A conventional carriage drive gear and DC (direct current) motor assembly may be coupled to drive an endless belt (not shown), which may be secured in a conventional manner to the carriage 45, with the DC motor operating in response to control signals received from the controller 40 to incrementally advance the carriage 45 along guide rod 44 in response to rotation of the DC motor. To provide carriage positional feedback information to printer controller 40, a conventional encoder strip may extend along the length of the printzone 25 and over the service station area 48, with a conventional optical encoder reader being mounted on the back surface of printhead carriage 45 to read positional information provided by the encoder strip. The manner of providing positional feedback information via an encoder strip reader may be accomplished in a variety of different ways known to those skilled in the art.

[0019] In the printzone 25, the media sheet 34 receives ink from an inkjet cartridge, such as a black ink cartridge 50 and three monochrome color ink cartridges 52, 54 and 56, shown schematically in FIG. 2. The cartridges 50-56 are also often called "pens" by those in the art. The black ink pen 50 is illustrated herein as containing a pigment-based ink. While the illustrated color pens 52-56 may contain pigment-based inks, for the purposes of illustration, color pens 52-56 are described as each containing a dye-based ink of the colors cyan, magenta and yellow, respectively. It is apparent that other types of inks may also be used in pens 50-56, such as paraffin-based inks, as well as hybrid or composite inks having both dye and pigment characteristics.

[0020] The illustrated pens 50-56 each include small reservoirs for storing a supply of ink in what is known as an "off-axis" ink delivery system, which is in contrast to a replaceable cartridge system where each pen has a reservoir that carries the entire ink supply as the printhead reciprocates over the printzone 25 along the scan axis 46. Hence, the replaceable cartridge system may be considered as an "on-axis" system, whereas systems which store the main ink supply at a stationary location remote from the printzone scanning axis are called "off-axis" systems. In the illustrated off-axis printer 20, ink of each color for each printhead is delivered via a conduit or tubing system 58 from a group of main stationary reservoirs 60, 62, 64 and 66 to the on-board reservoirs of pens 50, 52, 54 and 56, respectively. The stationary or main reservoirs 60-66 are replaceable ink supplies stored in a receptacle 68 supported by the printer chassis 22. Each of pens 50, 52, 54 and 56 have printheads 70, 72, 74 and 76, respectively, which selectively eject ink to from an image on a sheet of media in the printzone 25. The concepts disclosed herein for cleaning the printheads 70-76 apply equally to the totally replaceable inkjet cartridges, as well as to the illustrated off-axis semi-permanent or permanent printheads, although the greatest benefits of the illustrated system may be realized in an off-axis system where extended printhead life is particularly desirable.

[0021] The printheads 70, 72, 74 and 76 each have an orifice plate with a plurality of nozzles formed therethrough in a manner well known to those skilled in the art. The nozzles of each printhead 70-76 are typically formed in at least one, but typically two linear arrays along the orifice plate. Thus, the term "linear" as used herein may be interpreted as "nearly linear" or substantially linear, and may include nozzle arrangements slightly offset from one another, for example, in a zigzag arrangement. Each linear array is typically aligned in a longitudinal direction perpendicular to the scanning axis 46, with the length of each array determining the maximum image swath for a single pass of the printhead. The illustrated printheads 70-76 are thermal inkjet printheads, although other types of printheads may be used, such as piezoelectric printheads. The thermal printheads 70-76 typically include a plurality of resistors which are associated with the nozzles. Upon energizing a selected resistor, a bubble of gas is formed which ejects a droplet of ink from the nozzle and onto a sheet of paper in the printzone 25 under the nozzle. The printhead resistors are selectively energized in response to firing command control signals delivered by a multi-conductor strip 78 from the controller 40 to the printhead carriage 45.

[0022] FIG. 2 illustrates one form of an ink solvent dispensing service station 80 constructed in accordance with the present invention. The service station 80 includes a frame 82 which is supported by the printer chassis 22 in the servicing region 48 within the printer

casing 24. To service the printheads 70-76 of the pens 50-56, the service station 80 includes a moveable platform supported by the service station frame 82. Here, the servicing platform is shown as a rotary member supported by bearings or bushings (not shown) at the service station frame 82 for rotation, as illustrated by arrow 83, about an axis 84, which in the illustrated embodiment is parallel with printhead scanning axis 46. The illustrated rotary member comprises a tumbler body 85 which may have a drive gear 86 that is driven by a conventional service station motor and drive gear assembly (not shown). The tumbler 85 carries a series of servicing components, such as a capping assembly 88, into position for servicing the printheads 70-76. The capping assembly 88 preferably includes four discrete caps for sealing each of the printheads 70-76, although only a single capping unit is visible in the view of FIG. 2.

[0023] Other servicing components carried by the rotary platform 85 include a black printhead wiper 90 for servicing the black printhead 70, and three color wipers 92, 94 and 96 for servicing the respective color printheads 72, 74 and 76, although in the side view of FIG. 2, the yellow wiper 96 obscures the view of the cyan and magenta wipers 92, 94. Preferably, each of the wipers, 90-96 is constructed of a flexible, resilient, non-abrasive, elastomeric material, such as nitrile rubber, or more preferably, ethylene polypropylene diene monomer (EPDM), or other comparable materials known in the art. For wipers 90-96, a suitable durometer, that is, the relative hardness of the elastomer, may be selected from the range of 35-80 on the Shore A scale, or more preferably within the range of 60-80, or even more preferably at a durometer of 70 +/- 5, which is a standard manufacturing tolerance.

[0024] By placing the black wiper 90 along a different radial location on tumbler 85 than the radial on which the color wipers 92-96 are located, here, with the black and color wipers being shown 180° apart for the purposes of illustration, advantageously allows different wiping schemes to be employed for cleaning the black printhead 70 and for cleaning the color printheads 72-76. For instance, the color pens 52-56 carrying dye-based inks may be wiped using a faster wiping speed than required for wiping the black pen 50 which dispenses a black pigment-based ink. In the past, many service stations used wipers that required both the black and color printheads to be wiped simultaneously, so compromises had to be made between the optimum wiping speeds for the black pigment-based ink and the color dye-based inks. Problems were encountered in the past because the slower wiping strokes required to clean the black printheads extracted excess ink from the color printheads. When using a faster wiping stroke for the color pens, without allowing excess time for the color ink to seep out between the orifice plate and the wipers, the black wiper would then skip over black ink residue on the black printhead. These problems are avoided by service station 80, which places the black wiper 90 and the color wipers 92-96 at different locations around the periphery of the tumbler 85, thus allowing wiping to be optimized for both the black printhead 70 and for the color printheads 72-76.

[0025] As mentioned in the Background section above, the advent of permanent or semi-permanent inkjet printheads for use in off-axis printers, such as printer 20, particularly those using different types of ink, such as a pigment-based black ink and dye-based color inks, has proved challenging for service station designers. New servicing approaches were required to clean and maintain the pens without unnecessarily shortening the printhead lifespan. In studying various servicing routines, it was felt that use of an ink solvent may be the optimum approach to printhead cleaning. In particular, it would be even more desirable if the ink solvent also served to lubricate the printhead orifice plates during wiping, which would then avoid unnecessary wear or damage to the printheads, thereby insuring a long printhead life. Additionally, it would be highly desirable if the ink solvent also served as a non-stick coating for the printhead to repel the initial accumulation of ink residue. One such earlier proposed wiping system, described in the Background section above, unfortunately is susceptible to spillage when the printer is turned on its side or upside down, which often happens during transport or when moving one's office or home. This proposed wiping system is difficult to refill the ink solvent, which also may require replenishment during the life of the printer 20 to maintain high print quality.

[0026] To avoid these complications of accidental solvent spillage, and to address the potential need to refill the solvent system before the end of the useful life of the printing unit 20, FIG. 2 shows the service station 80 as including a first embodiment of a ink solvent dispenser member 100, constructed in accordance with the present invention. The solvent dispenser 100 has a hollow body or shell 102 with an exterior surface supported by the service station frame 82. Preferably, the shell 102 is constructed of a rigid hard plastic material, to define a chamber or reservoir 104 therein. The solvent dispenser 100 has a back pressure device contained within reservoir 104, with the first embodiment of the back pressure device being illustrated in FIG. 3 as a porous foam body 105. The foam body 105 has a main storage portion 106 that extends throughout the interior of the reservoir chamber 104. The shell 102 has a snout portion 107, with the foam body 105 having an applicator portion 108 which extends through a opening 109 defined by the snout 107.

[0027] While the applicator portion 108 of the foam body 105 may have a pore size similar to the main storage portion 106 within the reservoir 104, instead, preferably the applicator portion 108 has a higher capillary pressure than within the main portion 106 of body 105, as indicated by the closer spacing of the stippling shading of applicator 108, as compared to shading inside the cutaway section of shell 102 showing the main portion

106 of body 105 within reservoir 104. This higher capillary pressure of applicator 108 may be accomplished by providing the applicator with smaller average pore sizes and/or smaller wetting angles than in the main portion 106 of body 105. While the concept of capillary pressure is discussed in several places herein in terms of relative "pore sizes," it is apparent to those skilled in the art that this description is by way of illustration only of the broader concept of using capillary pressure to pull the solvent 110 through the cleaner 100. Furthermore, the references to relative "pore sizes" herein are clearly in terms of average pore size, because it is apparent to those skilled in the art that the individual pores within such a porous body vary in size, and in actuality are comprised of interlinking fluidic passageways often defined by fibrous wall segment of the porous material. The body 105 of dispenser 100 is impregnated or soaked with an inkjet ink solvent 110, preferably a hygroscopic material that absorbs water out of the air, because water is a good solvent for the illustrated inks. Suitable hygroscopic solvent materials include polyethylene glycol ("PEG"), lipponic-ethylene glycol ("LEG"), diethylene glycol ("DEG"), glycerin or other materials known to those skilled in the art as having similar properties. These hygroscopic materials are liquid or gelatinous compounds that will not readily dry out during extended periods of time because they have a nearly zero vapor pressure. For the purposes of illustration, the body 105 is soaked with the preferred ink solvent, a PEG solution 110.

[0028] The higher capillary pressure of the applicator 108 extracts the PEG 110 from the main storage portion 106 through capillary action, as the PEG moves from the larger pores of main storage 106 toward the smaller pores of the applicator portion 108. This capillary or wicking action is used in operating replaceable inkjet cartridges, which are often foam filled to contain the ink used during printing. This capillary action provides a back-pressure for these cartridges to prevent the ink from leaking or drooling out of the ink ejection nozzles. This same capillary back-pressure action advantageously prevents the ink solvent 110 from leaking out of the applicator 108. Moreover, by locating a substantial portion of the main storage 106 to reside vertically above the applicator portion 108, the force of gravity also acts to pull the PEG ink solvent 110 downward through the main storage portion 106 to the level of the applicator 108, as is apparent from the views of FIGS. 2 and 3.

[0029] In FIG. 2, the wipers 92, 94 and 96 are illustrated in dashed lines as being coated with PEG through contact with the applicator 108. From this position, the wipers 92-96 traverse across the printheads 72-76 through rotation of the tumbler body 85 along the direction indicated by curved arrow 83. Indeed, in some wiping schemes, the wipers 90-96 may make a single pass along the printheads 70-76, while at other times it may be advantageous to wipe back and forth (clockwise and counterclockwise rotation of tumbler 85) across the printheads 70-76. FIG. 2 shows wiper 90 as just recently having wiped the black printhead 70, and carrying ink residue 112 thereon, along with some remaining PEG solvent 110' dirtied by ink residue dissolved therein. Through rotation of the tumbler body 85 as indicated by arrow 83, the black wiper 90 contacts a portion of a wiper scraper 114 which is supported by the service station frame 82.

[0030] It is apparent that while in the illustrated embodiment of FIG. 2, the ink solvent dispenser 100 and the wiper scraper 114 are illustrated as being supported along the vertical portions of the service station frame 82, they may be also supported from a lower surface 116 of the frame 82, or alternatively, from interior surfaces of inboard or outboard side-wall portions, or from an under-surface of an over-hanging wall portion (not shown) of the service station frame 82. Preferably, the wiper scraper 114 has holes, slots or other provisions which allow the ink residue 112 to fall from the upper collection surface of scraper 114 into a collection pit or to merely accumulate along the lower surface 116 of the service station frame 82, as indicated by arrow 117 in FIG. 2. Indeed, provisions may be made within the service station 80 for separate handling of residue from the color wipers 92-96, and from the black wiper 90, since the color wipers clean pens 52-56, which dispense die-based color inks, whereas the black wiper 90 cleans the black pen 50 which dispenses a black pigment-based ink, with the die-based inks typically having different servicing needs that the black pigment-based ink dispensed by pen 50.

[0031] Referring again to FIG. 3, as the PEG solvent 110 is drained from the main foam reservoir 106 during operation of printer 20, make-up air may enter the reservoir chamber 104 through gaps between the applicator 108 and the snout opening 109, or through other vent means, such as a labyrinth vent path 118 illustrated in FIG. 3. Use of the labyrinth vent path 118, rather than a straight through vent hole, advantageously provides a slower more tortuous path for the make-up air to enter the reservoir chamber 104, which also allows the dispenser 100 to adapt gradually to changes in atmospheric pressure. A variety of ways to accommodate for changes in atmospheric pressure are known to those skilled in the inkjet art, not only during normal weather changes, but when transporting an Inkjet printer or cartridge contained therein over varying elevations, such as when traveling over mountains or when flying in a airplane, and any of these back-pressure/vent systems may be suitable to contain the ink solvent 110 inside shell 102. For instance, the dispenser 100 may have a back pressure device within chamber 102 which may be constructed in a fashion similar to the foam back-pressure device used in inkjet cartridges for containing inkjet ink, such as the back-pressure device described in U.S. Patent No. 5,477,255, assigned to the present assignee, the Hewlett-Packard Company of Palo Alto,

California.

[0032] FIGS. 4 and 5 illustrate a second embodiment of an ink solvent dispenser 120 constructed in accordance with the present invention, which may be substituted for the foam-filled dispenser 100 in the service station 80 of FIG. 2. The dispenser 120 includes a shell or body 122 defining a reservoir chamber 124 therein, which may be constructed as described above and shown for shell 102 and reservoir 104. The dispenser 120 has a back pressure device 125 within chamber 122 which may be constructed in a similar fashion to the back-pressure device used in inkjet cartridges for containing inkjet ink, such as the back-pressure device described in U.S. Patent No. 5,409,134, assigned to the present assignee, the Hewlett-Packard Company of Palo Alto, California.

[0033] The illustrated back pressure device 125 has one or more spring bags, such as a pair of spring-bags 126, 128, each of which has a curvature shaped leaf spring 130 and 132 contained therein. The spring bags 126, 128 are inserted within the reservoir chamber 124 and the shell 122 defines an air vent 134 to provide make-up air to the bags 126, 128 from atmosphere. The interior of the reservoir chamber 124 is filled with the ink solvent 110, as described above with respect to dispenser 100, and illustrated herein as containing the preferred PEG solvent. The manner of venting atmospheric pressure to the spring bags 126, 128 may be accomplished in the same or equivalent manner to that described in U.S. Patent No. 5,409,134, mentioned above.

[0034] The dispenser 120 includes a applicator 135 constructed of a porous material, preferably including a vent path such as the labyrinth path 118, for instance as described above with respect to the applicator 108 of FIGS. 2 and 3. In a preferred embodiment, the porous material is of a high density polyethylene (HDPE). The dispenser body 122 has a snout portion 136 that defines an opening 138 through which the porous applicator 135 extends. The applicator 135 is in fluid communication with the interior of the reservoir chamber 124 to receive the solvent 110 contained therein. As the solvent 110 is depleted from the reservoir 124, the spring bags fill with air. The springs 130, 132 provide a positive back pressure that prevents the solvent 110 from leaking or drooling from the applicator 135. Alter the bags 130, and 132 are full, make-up air is advantageously introduced into the chamber 124 through the labyrinth 118 as further fluid 110 is withdrawn. Wicking or capillary forces draw the solvent into the applicator 135 from the chamber 124. Each of the wipers 90-96 receive the solvent from applicator 135 and then wipe the printheads 70-76, followed by wiper cleaning at scraper 114 to complete the wiping sequence, as described above with respect to FIG. 2.

[0035] While the dispensers 100, 120 have been illustrated with two different back pressure devices 105, 125 within shells 102, 122, it is apparent to those skilled in the art that other back pressure devices may also be substituted within shells 102, 122. For instance, it is apparent to those skilled in the art that the foam back pressure device 105 of dispenser 100 may be constructed using a homogeneous foam throughout the main body 106 and the applicator 108, with compression of the applicator 108 when contacted by the wipers 90-96 providing the capillary forces to draw the ink solvent 100 toward the applicator 108; however, the preferred embodiment is illustrated as having different porosities between the main fob storage body 106 and the applicator 108, with smaller pores in the applicator 108 serving to urge the PEG 110 toward the applicator 108. Indeed, this flow toward the applicator may be more readily accomplished by using one or more intermediate foam layers (not shown) having pores of an intermediate sizes between those of the main storage body 106 and the applicator 108.

[0036] Furthermore, while the illustrated solvent dispensers 100, 120 are shown as being permanent fixtures within the service station 82, it is apparent to those skilled in the art that the service station frame 82 may be constructed with slots 140 or other latching devices to slideably or otherwise interchangeably receive the dispensers 100, 120. In this manner, the PEG fluid 110 may be periodically replaced by installing a new dispenser 100, 120 within the service station frame 82. Such replacement schemes for consumables are well known to those in the inkjet art, and are commonly employed when installing replacement inkjet cartridges within inkjet printers, plotters, or other inkjet printing mechanisms. Indeed, two recently introduced inkjet plotters sold by the Hewlett-Packard Company of Palo Alto, California as DesignJet® 2000CP and 2500CP models not only allow for placement of the inkjet pens, but also allow for replacement of the inkjet pen service station modules, which allows different types of inks to be serviced by compatible service stations.

[0037] In a preferred embodiment, the applicators 108, 135 are constructed of a sintered, high density polyethylene (HDPE) plastic. A sintered plastic is preferred because the sintering process serves to create a porous plastic matrix that allows fluid flow through a rigid plastic body. To increase the surface energy of the applicators 108, 135, preferably the applicator surfaces are plasma treated before assembly into shells 102, 122. In plasma treating, the entire applicator 108, 135 is placed in a pressure-controlled cavity wherein the residing air is substantially evacuated, after which a gas is added to the cavity and a high frequency voltage is applied to the cavity. This high frequency voltage turns the gas into a plasma which then changes the surface chemistry of the solid by replacing some atoms with atoms from the gas. Through this plasma treatment process, the surface energy of the plastic can be drastically altered, and in the illustrated embodiment, this surface energy is raised, resulting in a smaller wetting angle, which in turn yields a larger capillary pressure.

Typical gas additives are nitrous oxide, oxygen, or helium. Following this plasma treating process, the ink solvent 110 may be impregnated within the applicators 108, 135, as well as within the main foam storage reservoir 106 of applicator 100, through immersion of components 106, 108, 135 within liquid solvent 110. Alternatively, these foam components 106, 108, 135 may be force-filled with ink solvent 110 by drawing a vacuum through these components to eliminate air within the pores, followed by introduction of the ink solvent, which would eliminate the need for plasma treating of components 106, 108, 135. Filling of the reservoir 124 of applicator 120 may be easily accomplished by pouring ink solvent 110 through the snout opening 138 before assembling the applicator 135 into this opening of the snout 136.

[0038] It is apparent that the exterior shape of shells 102, 122 may vary, depending upon the scheme used to apply the solvent 110 to printheads 70-76, or depending upon how the dispensers 100, 120 are installed in or attached to the service station frame 82, or alternatively, to the printer chassis 22. Indeed, while the exterior shape of the bodies 102, 122 may change, the operating principles illustrated herein remain substantially the same. For instance, rather than one dispenser 100 or 120 providing PEG 110 to all of the printhead wipers 90-96, separate shells 102, 122 may be used to apply solvent individually to each wiper 90-96. Alternatively, two different shells may be used to apply solvent, indeed even different types of solvent, to wipers servicing printheads having different types of ink, such as one dispenser providing a die-based ink solvent, here to color wipers 92-96, and a separate dispenser applying a pigment-based solvent, here to the black wiper 90. Furthermore, while the illustrated service station 80 shows a rotary platform 85 for transporting the wipers 90-96 from the dispenser 100, 120, to the printheads 70-76, then to the scraper 114, it is apparent to those skilled in the art that other mechanisms may also be used for wiper movement, such as translational sliding platforms, or ramp-operated platforms that move in response to printhead movement provided by the carriage 45.

Conclusion

[0039] Thus, a variety of advantages are realized using the ink solvent dispensers 100, 120 in service station 80. For example, use of a replaceable ink solvent dispenser 100, 120 advantageously allows for easy replacement of a empty dispenser with a fresh one during the lifespan of printer 20. Moreover, by containing the ink solvent 110 within dispenser 100, 120, accidental ink spills are avoided, such as when printer 20 is stored or transported in other than a normal, upright position. Additionally, use of a back-pressure device 105, 125 for containing ink solvent 110 within the dispensers 100, 120 advantageously prevents unnecessary leakage or wicking of the solvent 110 from the dispensers, and thus preserves the solvent for use in wiping the printheads 70-76. Furthermore, the dispensers 100, 120 are capable of storing a large volume of the ink solvent 110 in a very small space within printer 20, more than is currently possible in the proposed systems described in the Background section above. These dispenser systems 100, 120 advantageously facilitate more efficient packaging of the solvent fluid 110 by storing this fluid in a reservoir pool, rather than in an open foam pad as previously proposed. Furthermore, use of the porous applicators 108, 135 advantageously moves the ink solvent 110 more quickly from the reservoirs 104, 124 than in the proposed system described in the Background section above.

Claims

1. An ink solvent dispenser system (100; 120) for cleaning an inkjet printhead (70, 72, 74, 76) in an inkjet printing mechanism (20) having a printhead wiper (90, 92, 94, 96), comprising:

   an enclosure shell (102; 122) defining a reservoir (104; 124) therein;
   an ink solvent (110) stored in the reservoir (104; 124);
   a back-pressure device (105; 125) for retaining the ink solvent (110) within the reservoir (104; 124) before application; and
   an applicator (108; 135) in fluid communication with the ink solvent (110) stored within the reservoir (104; 124), with the applicator (108; 135) supplying ink solvent (110) to the printhead wiper (90, 92, 94, 96) through contact of the wiper (90, 92, 94, 96) with the applicator (108; 135).

2. An ink solvent dispenser system according to claim 1 wherein the back-pressure device (105) comprises a body (106) of a porous material housed within the shell reservoir (104).

3. An ink solvent dispenser system according to claim 2 wherein:

   the porous material of the body (106) of the back-pressure device has a first capillary pressure; and
   the applicator (108) comprises a porous material that has a second capillary pressure greater than said first capillary pressure to draw the ink solvent (110) through capillary forces from the reservoir (104) into the applicator (108).

4. An ink solvent dispenser system according to claim 1, wherein the back-pressure device (125) comprises a spring-bag structure (126, 128) located

inside the reservoir (124) and immersed within the ink solvent (110), with the spring-bag structure (126, 128) comprising a liquid-impervious bladder defining an interior chamber in communication with atmosphere through a vent (134) defined by the shell (122), and with the bladder interior chamber being isolated from the ink solvent (110) and containing a biasing member (130, 132).

5. An ink solvent dispenser system according to any of claims 1 through 4, wherein the porous material of the applicator is of a sintered, high density polyethylene plastic (108; 135).

6. An ink solvent dispenser system according to any of claims 1 through 5 wherein:

the inkjet printing mechanism (20) has provisions (140) for replaceably receiving the ink solvent dispenser system (100; 120); and
the shell (102; 122) has an exterior mounting portion configured to be replaceably installed in said provisions (140) of the inkjet printing mechanism (20).

7. A service station (80) for cleaning an inkjet printhead (70, 72, 74, 76) in an inkjet printing mechanism (20), comprising:

a wiper (90, 92, 94, 96);
a platform (85) that supports the wiper (90, 92, 94, 96) for movement between a wiping position for cleaning ink residue (112) from the printhead (70, 72, 74, 76), and an application position; and
an ink solvent dispenser system (100; 120) according to any of claims 1 through 5.

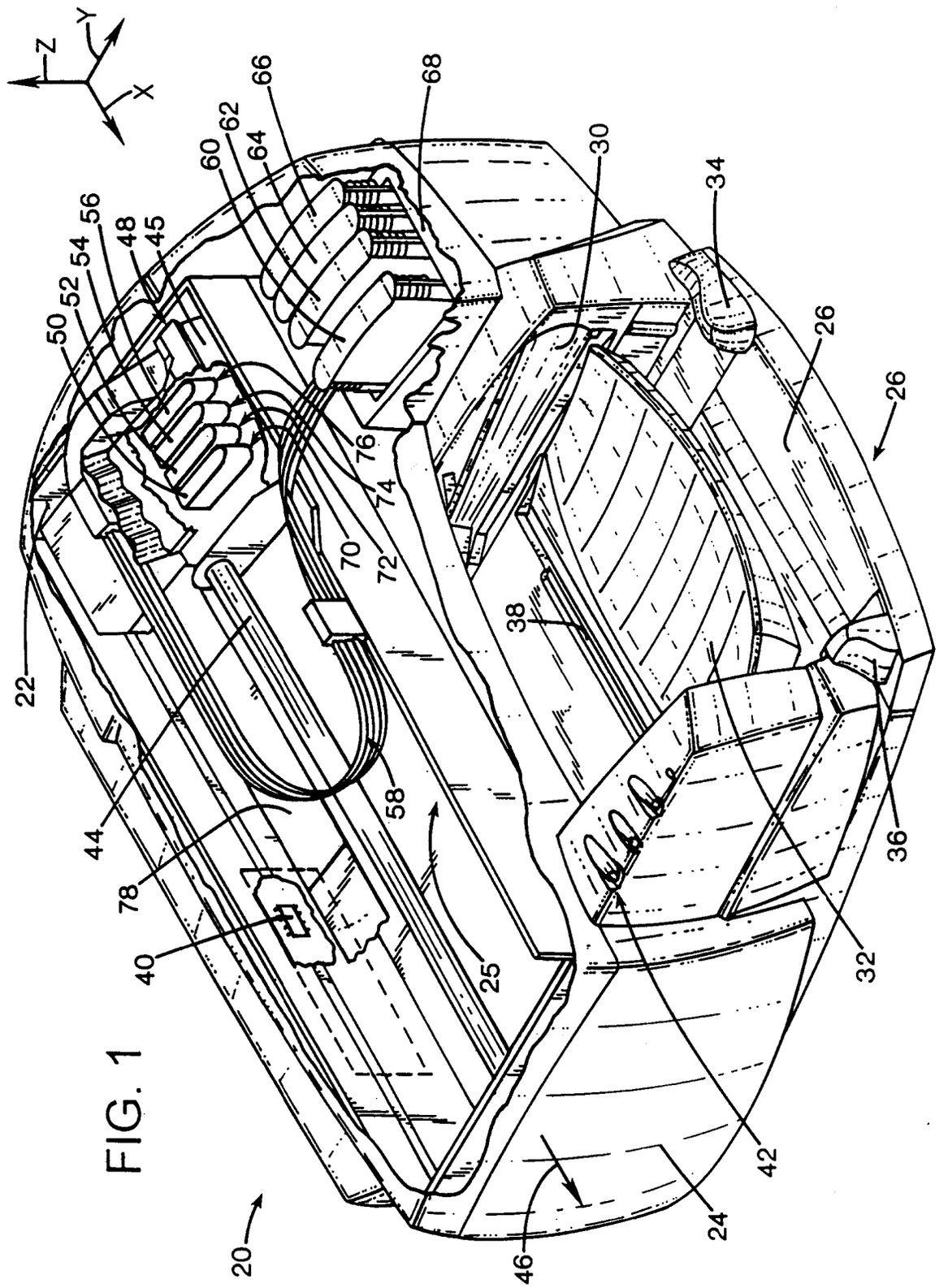
8. An inkjet printing mechanism (20), comprising:

an inkjet printhead (70, 72, 74, 76);
a carriage (45) that reciprocates the printhead (70, 72, 74, 76) through a printzone (25) for printing and to a servicing region (48) for printhead servicing; and
a service station (80) according to claim 7.

9. An inkjet printing mechanism according to claim 8 wherein the service station frame (82) has provisions (140) for replaceably receiving the ink solvent dispenser, and the shell (102; 122) has an exterior mounting portion configured to be replaceably installed in said provisions (140) of the frame (82).

10. A method of dispensing ink solvent (110) for cleaning an inkjet printhead (70, 72, 74, 76) in an inkjet printing mechanism (20) having a printhead wiper (90, 92, 94, 96), comprising the steps of:

storing a supply of an ink solvent (110) within a reservoir enclosure (102, 104; 122, 124);
preventing leakage of the ink solvent (110) from the reservoir enclosure (102, 104; 122, 124) by maintaining a back-pressure within the reservoir enclosure;
supplying the ink solvent (110) to the printhead wiper (90, 92, 94, 96) through an applicator (108; 135) in fluid communication with the ink solvent stored within the reservoir enclosure(102, 104; 122, 124); and
extracting the ink solvent (110) from the reservoir enclosure (102, 104; 122, 124) and through the applicator (108; 135) through the use of capillary forces supplied by the applicator (108; 135).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20

FIG. 1

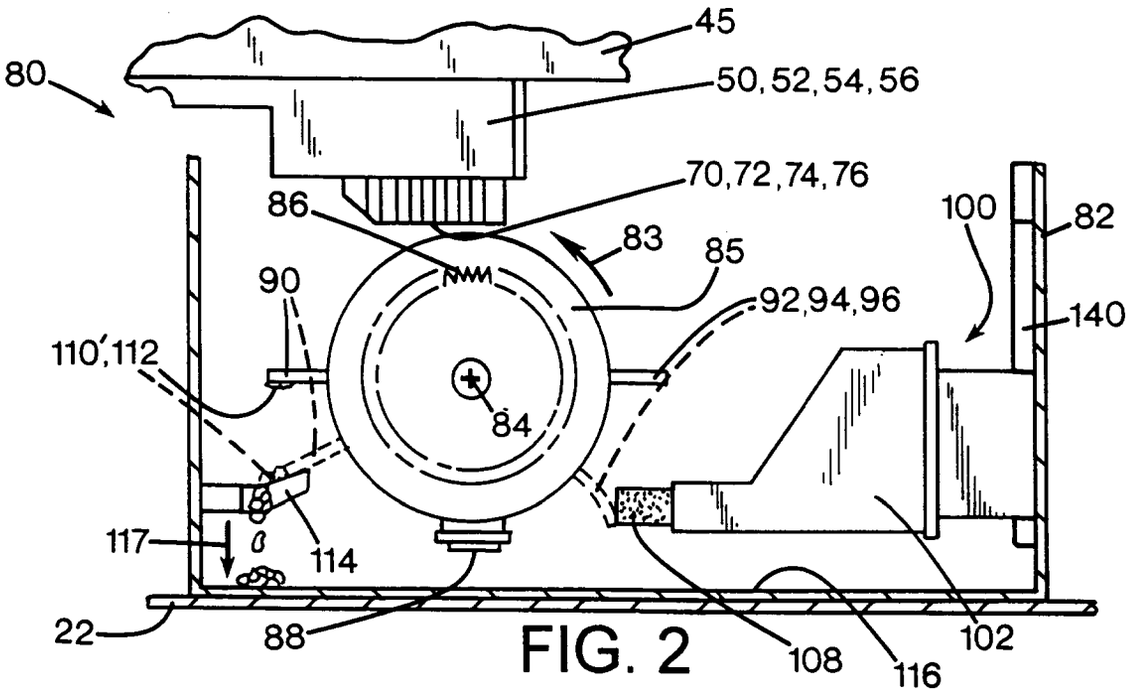

45
80
50, 52, 54, 56
70, 72, 74, 76
86
83
85
100
82
90
92, 94, 96
140
110', 112
84
117
θ
114
22
88
108
116
102

FIG. 2

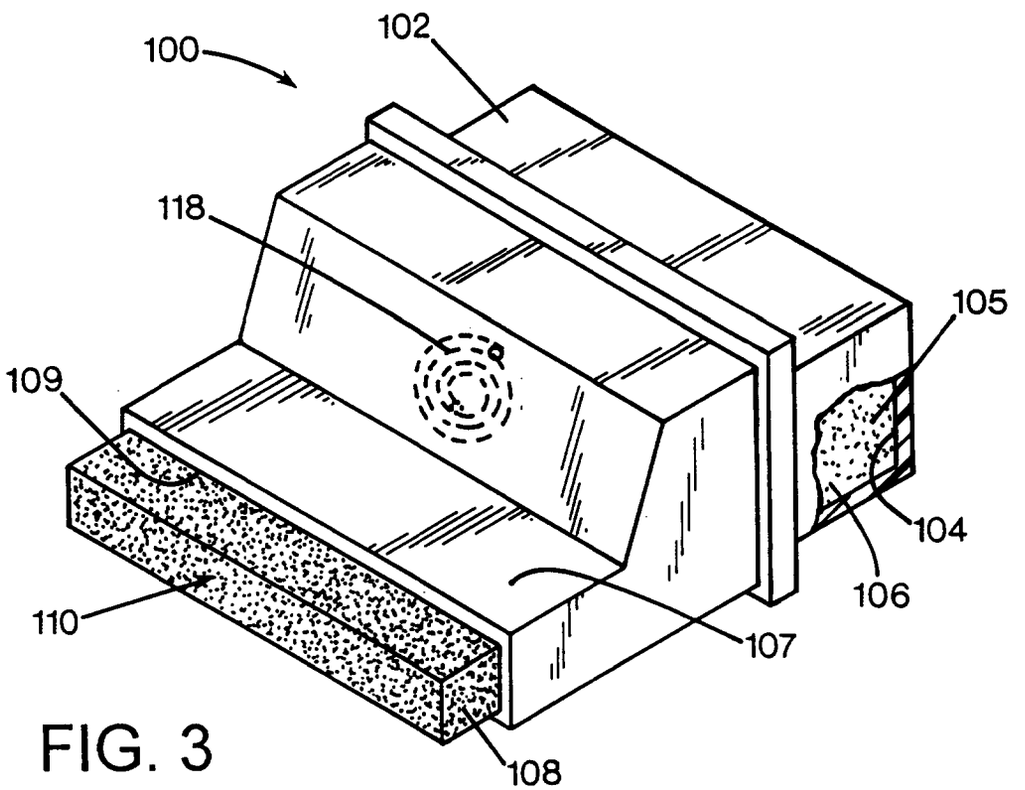
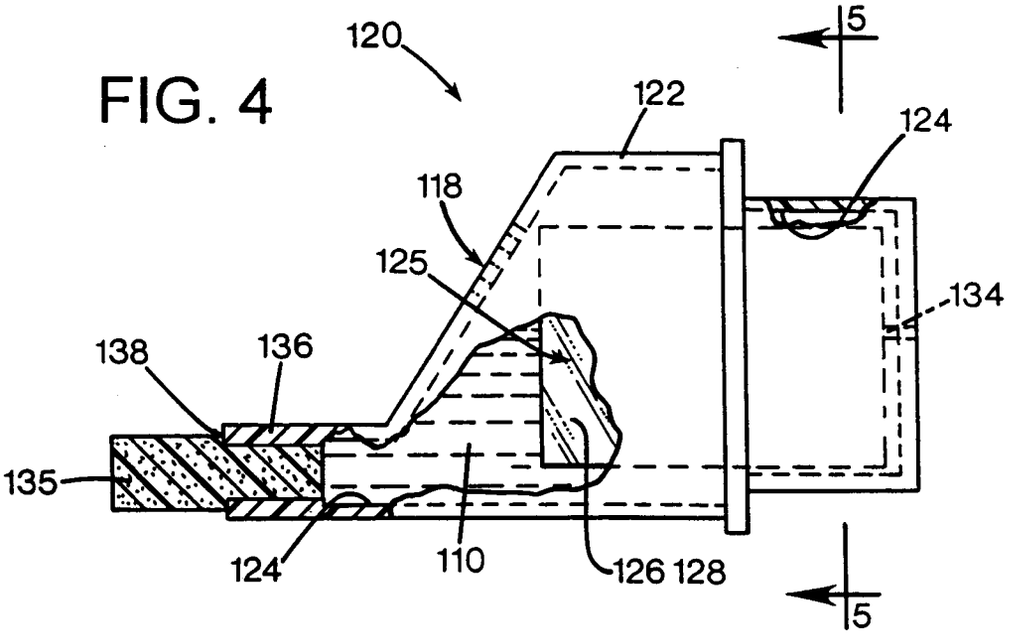

100
102
118
105
109
104
106
110
107
108

FIG. 3

FIG. 4


120
5
122
124
118
125
134
138
136
135
124
110
126 128
5

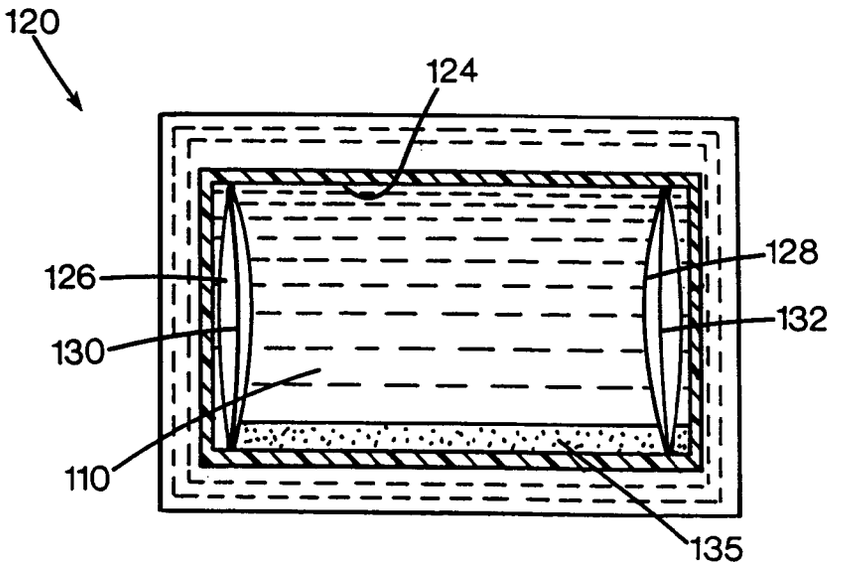

120
124
126
128
132
130
110
135

FIG. 5