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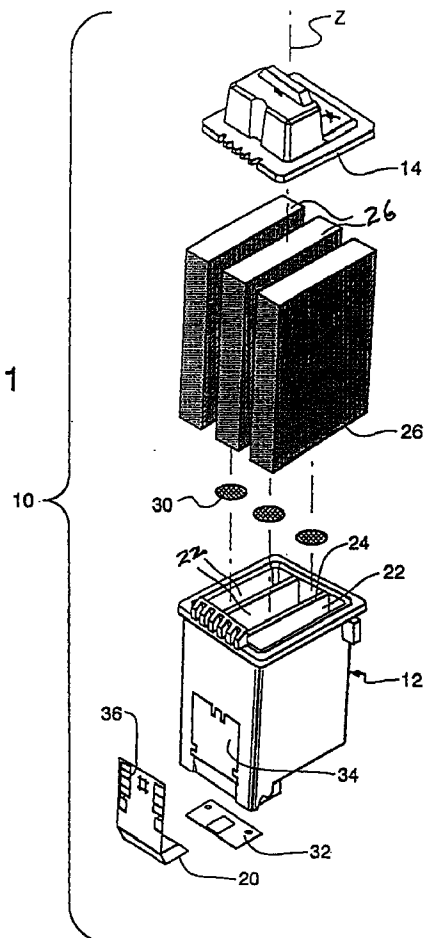
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(54) **Ink-jet print cartridge body**

(57) An opening extending to an outer surface of a cartridge body is closed by a polymeric material sealant plug formed in situ. The cartridge body includes an ink flow pathway which interconnects an ink reservoir chamber to an exit port. The opening, which extends from a duct of the ink flow pathway of the cartridge body to the outer surface of the body, is closed by injecting a polymeric material into the opening. It is currently preferred to use a thixotropic material such as a thermoset urethane adhesive.

Fig. 1



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## Description

### FIELD OF THE INVENTION

The present invention relates to ink-jet printer pens or cartridges, and more particularly to an ink-jet printer cartridge body having an opening extending from a duct of an ink flow pathway to an outer surface of the ink-jet cartridge body and a sealant plug formed in situ to close the opening.

### BACKGROUND OF THE INVENTION

Color ink-jet printers employ cartridges having ink reservoirs divided into three distinct chambers, each chamber holding ink of one of three primary colors, for example cyan, magenta and yellow. The architecture of such cartridges is more complicated than monochromatic cartridges since ink flow pathways from the three chambers converge into a small region at a printhead. The cartridges include a cartridge body which may be molded as a monolithic body of plastic material as disclosed in U.S. Patent No. 5,497,178 of DeFosse et. al. which is assigned to the same assignee as the present application and incorporated herein by reference.

In order to mold duct portions of ink flow pathways in a cartridge body, core pins are inserted into a mold and, after molding, the core pins are withdrawn resulting in openings extending between the duct portions of the flow paths and an outer surface of the cartridge body. To close the openings in the cartridge body, preformed rigid plugs formed of the same material as the cartridge body have been inserted into the openings and ultrasonically welded therein as disclosed in the referenced DeFosse et. al. patent. To improve upon the ink flow pathways, an improved plug for closing the openings is disclosed in U.S. Patent No. 5,576,750 of Brandon et. al. which is assigned to the same assignee as the present application and is incorporated herein by reference. The improved plugs of the Brandon et. al. patent are formed to improve the internal formation of the ink flow pathways to better accommodate movement of air bubbles formed within the ink flow pathways of the cartridges.

Unfortunately, placement of the rigid plugs disclosed in the DeFosse et. al. and Brandon et. al. patents can cause microscopic flash to be released into the ink flow pathways in the cartridge body. The microscopic flash can then travel to the printhead and result in clogs in ink flow channels within the printhead. To minimize the flash, tight tolerances are required for the plugs, opening dimensions and plug placement within the openings. In addition, the rigid plugs must be prepared for use by cleaning to remove surface contaminating microscopic flash. All of these requirements add to the cost of the ink-jet cartridges.

It is desired to improve the reliability and reduce the cost of manufacturing ink-jet cartridges by reducing if

not eliminating the microscopic flash which can be introduced by the insertion of prior art rigid plugs to close openings in ink-jet cartridges resulting from the withdrawal of core pins used to form ducts of ink flow pathways within the cartridges.

### SUMMARY OF THE INVENTION

The instant invention is directed to an ink-jet printer cartridge body wherein an opening extending to an outer surface of the cartridge body is closed by a sealant plug formed in situ in the opening and a method for making an ink-jet printer cartridge including at least one sealant plug. The cartridge body includes an ink flow pathway which interconnects an ink reservoir chamber to an exit port. The opening, which extends from a duct of the ink flow pathway of the cartridge body to the outer surface of the body, is closed by a polymeric material sealant plug formed by injecting a polymeric material into the opening. By thus forming a sealant plug in situ, the corresponding opening is sealed frictionlessly. Any microscopic flash within the opening is entrapped by the sealant plug which can be maintained in a sealed container to prevent contamination.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view of a tri-color ink-jet cartridge in which the invention is utilized;

FIG. 2 is a perspective view of a cartridge body of the cartridge of Fig. 1 with a portion cut away to show connecting ducts and standpipes;

FIG. 3 is a perspective view of the bottom portion of the cartridge body of Fig. 2 showing exit ports through which ink exits from the cartridge body;

FIG. 4 is a sectional perspective view of the cartridge body of Fig. 2 looking upwardly into the ink flow pathways; and

Fig. 5 is a sectional view taken vertically through an ink flow path and illustrating a sealant plug of the present invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference will now be made to the drawing figures wherein Fig. 1 illustrates a tri-color ink-jet cartridge 10 or pen comprising a cartridge body 12, a lid 14 and a tape automated bonding (TAB) circuit 20 having a printhead (not shown) attached thereto. The cartridge body 12 is formed of a polymeric material, for example, like polysulfone, polyvinyl chloride and, preferably modified polyphenylene oxide which is commercially available from the General Electric Company under the trademark "NORYL SE-1", and has a hollow interior divided into a center and two side ink reservoir chambers 22 by two dividing walls 24. Three blocks of foam material 26 are disposed in the reservoir chambers 22 and the

chambers are each filled or later refilled with an ink of a different color. At the bottom of each of the reservoir chambers 22 is a standpipe 28 and the top of each standpipe is covered with a filter 30 for filtering the ink as it is withdrawn from a chamber.

The TAB circuit 20 is attached to the bottom and front surface of the cartridge body 12 by two adhesive preforms 32, 34. The TAB circuit 20 carries terminals 36 which conduct electrical signals from a printer energy supply circuit (not shown) to a heater chip forming part of the printhead to control ejection of ink through nozzles or orifices in a nozzle plate also forming part of the printhead. Inks in the reservoir chambers 22 are drawn from the chambers 22 through filters 30 and the standpipes 28 during printing.

The cartridge body 12 is formed with three ink flow pathways 38, 41, 45 or passages, as shown by dash-dot lines in FIG. 2, which extend from the reservoir chambers 22 to three exit ports 46, 48 and 50 located within a recess 52 in a bottom surface 54 of the cartridge body 12 as shown in Fig. 3. The ink flow pathways 41, 45 include duct portions 42, 40, respectively, see Figs. 2 and 4. The printhead comprises print means and is mounted to the surface 54 of the cartridge body 16 so that the three colored inks available at the exit ports 46, 48 and 50 can be selectively ejected through groups of nozzles in the nozzle plate to cause printing in a conventional manner.

The bottoms of the standpipes 28 are partially closed by sloping bottom surfaces 56, see FIG. 2, so that the openings 44 of approximately semi-circular configuration are formed in the bottoms of the standpipes 28. The first ink flow pathway 38 extends from the center ink reservoir chamber 22 to the exit port 46 and includes the center standpipe 28 and a short ink feed tube 39, the ink feed tube 39 extending parallel to the vertical or Z axis, see FIG. 1, of the cartridge 10 between the opening 44 and the exit port 46. Two ridges 58 are provided which extend along the entire length of the interior walls of the center standpipe 28 and feed tube 39. These ridges serve to wick ink from the center chamber 22 and also prevent air bubbles from completely blocking the feed tube or standpipe.

The standpipes 28 for the side reservoir chambers 22 are also provided with ridges 60 and 62, respectively, extending vertically along the entire length of the interior walls of the standpipes. Only one ridge 60 and one ridge 62 is visible in FIG. 2 although the two ridges 60 for the left side standpipe of FIG. 2 are visible in FIG. 4. As shown in FIG. 4, which is a sectional perspective view looking toward the standpipe openings 44, one of the ridges 60 joins with a ridge 64 that extends along the entire length of the top wall 86 of the duct 40.

The second ink flow pathway 41 extends from the right side ink reservoir chamber 22 of FIG. 2 to the exit port 48. The second ink flow pathway 41 includes the right-hand standpipe 28, the duct portion 42, and a short feed tube 43, see FIG. 5.

The duct portion 42 is irregular in shape and is bounded by a top wall 66, a bottom wall 68, and two side walls 70 and 72, see Figs. 4 and 5. The side walls 70 and 72 converge to close one end of the duct, the point of convergence being slightly beyond where feed tube 43 joins an opening 73 in the bottom wall. The other end of the duct portion 42 extends to an outer surface 12A of the cartridge body 12 through an opening 42A which accommodates removal of a core pin during molding of the cartridge body 12. Ink from the right standpipe 28 of FIG. 2 enters the duct 42 through an opening 75 in the top wall 66. As shown in FIG. 5, the standpipe opening 44 is connected with the opening 75 by a short passage 77.

The duct 42 is generally trapezoidal in cross-section. Side walls 70 and 72 intersect the top wall 66 at acute angles. Since air bubbles assume nearly spherical shapes they will not nest into the acute angles, hence they cannot completely block the flow of ink through the duct 42.

The third ink flow pathway 45 connects the left ink reservoir chamber 22 to the exit port 50, see FIG. 3. The pathway 45 is similar to the pathway 41 and will not be described in detail except to note that it includes a duct portion 40 which extends to an outer surface of the cartridge body 12 through an opening 40A, is provided with side walls 80 and 82 intersecting a top wall 86 at acute angles, a ridge (not shown) on the side wall 80 and a further ridge 64 on the top wall 86.

The cartridge body 12 may be molded as a monolithic body of plastic material as explained in the referenced DeFosse et al. patent. In order to mold the duct portions 40 and 42, it is necessary to provide corresponding openings 40A, 42A in the cartridge body 12 through which core pins of the mold tool may be withdrawn after the cartridge body 12 is formed. After the core pins are withdrawn, the openings 40A, 42A must be closed to prevent ink from leaking from the ink-jet cartridge 10. In the prior art, preformed rigid plugs formed of the same material as the cartridge body 12 have been inserted into the openings and ultrasonically welded therein as noted in the "Background of the Invention" portion of the application. To improve upon the ink flow pathways, an improved plug for closing the openings is disclosed in the referenced Brandon et. al. patent. The plugs of the Brandon et. al. patent are formed to improve the internal formation of the ink flow pathways to better accommodate movement of air bubbles formed within the ink flow pathways the cartridges.

Unfortunately, placement of the rigid plugs of the prior art can cause microscopic flash to be released into the ink flow pathways 41, 45 which can result in clogs in internal channels in the printhead, thereby preventing ink from being ejected from one or more of the nozzles in the printhead. To ensure proper seal and to minimize the flash, tight tolerances are required for the rigid plugs, the dimensions of the openings and the placement of the rigid plugs within the openings. In addition,

the rigid plugs must be prepared for use by cleaning to remove surface contaminating microscopic flash. All of these requirements add to the production time and cost of manufacturing ink-jet cartridges. These problems of the prior art are overcome by the invention of the present application wherein the rigid plugs are replaced by sealant plugs which are formed in situ in the openings 40A, 42A. Since the sealant plugs are substantially identical to one another, only sealant plug 42P which is formed in the opening 42A is illustrated, see Fig. 5.

The sealant plugs are formed by injecting a polymeric material into the openings 40A, 42A. The sealant plugs may be made using a thermoset material such as a thermoset adhesive or a thermoplastic material such as a thermoplastic adhesive which is capable of withstanding the temperatures encountered for completing the production of the ink-jet cartridge 10 and is compatible with inks to be used in the cartridge 10. Thermoset adhesives which can be used to form the sealant plugs include epoxy resins, polyurethanes, silicone resins and phenolic resins. Thermoplastic adhesives which can be used to form the sealant plugs include ethylene-vinyl acetates, ethylene ethylacrylates, polyamides, polyesters, polyurethanes and polystyrenes. Other thermoplastics which can be used to form the sealant plugs include high molecular weight materials such as polyolefins, polyesters and polyurethanes. It is currently preferred to use a thixotropic material such as a thermoset urethane adhesive to form the sealant plugs. In particular, the currently preferred thermoset urethane adhesive is a one-component moisture curing urethane adhesive sold under the trademark "Jet-Weld TE-031" by Minnesota Mining and Manufacturing (3M), although tests have also been made using a two-part epoxy adhesive sold under the trademark "Scotch-Weld DP-11" by 3M.

The sealant is injected into each of the openings 40A, 42A. The sealant may be injected using a commercial adhesive applicator (not shown) such as one which is sold under the "Jet-Weld" trademark by 3M. The adhesive applicator may be manually operated or it may be incorporated into a cartridge production apparatus (not shown) such that its operation is machine controlled. The volume or shot size of the sealant is selected to seal the opening into which it is injected. In the illustrated embodiment of the invention, each of the openings 40A, 42A have a defined volume and, preferably, the shot size of the sealant is selected to substantially equal the volume of the corresponding opening. By using a volume of sealant which is substantially equal to the opening to be closed, an inner surface 90 of the sealant plug 42P forms a portion of the ink flow pathway 41 and forms a junction portion 92 of the ink flow pathway 41 which junction portion 92 surrounds the plug 42P.

The injection of a sealant into the openings 40A, 42A frictionlessly closes the openings 40A, 42A to prevent microscopic flash from being produced by formation of the sealant plugs. In addition, any microscopic

flash which may be present within the openings 40A, 42A is entrapped by injection of the sealant. In this way, no microscopic flash is produced by insertion or formation of the sealant plugs and any such flash which may be present in the openings 40A, 42A of the cartridge body 12 is captured by the sealant plugs.

While a preferred embodiment has been described in specific detail by way of illustration, it will be obvious that various modifications and substitutions may be made in the form and details of the described embodiment without departing from the spirit and scope of the invention as defined by the appended claims.

#### Claims

1. An ink-jet printer cartridge body comprising an opening extending to an outer surface of said ink-jet cartridge body and a sealant plug formed in situ in said opening.
2. An ink-jet printer cartridge body as claimed in claim 1 wherein said body further includes an ink flow pathway and said opening extends to said ink flow pathway.
3. An ink-jet printer cartridge body as claimed in claim 2 wherein said body is formed of a polymeric material.
4. An ink-jet printer cartridge body as claimed in claim 3 wherein said polymeric material of said body comprises a modified polyphenylene oxide.
5. An ink-jet printer cartridge body as claimed in claim 1 wherein said plug is formed of a polymeric material.
6. An ink-jet printer cartridge body as claimed in claim 5 wherein said polymeric material of said plug is selected from the group consisting of thermoset adhesives, thermoplastics adhesives and thermoplastics.
7. An ink-jet printer cartridge body as claimed in claim 5 wherein said polymeric material of said plug is selected from the group consisting of epoxy resins, polyurethanes, silicone resins and phenolic resins.
8. An ink-jet printer cartridge body as claimed in claim 5 wherein said polymeric material of said plug is selected from the group consisting of ethylene-vinyl acetates, ethylene ethylacrylates, polyesters, polyurethanes and polystyrenes.
9. An ink-jet printer cartridge body as claimed in claim 5 wherein said polymeric material of said plug is selected from the group consisting of polyolefins, polyesters and polyurethanes.

10. An ink-jet printer cartridge body as claimed in claim 5 wherein said polymeric material of said plug comprises a thixotropic material.
11. An ink-jet printer cartridge body as claimed in claim 10 wherein said thixotropic material of said plug comprises a thermoset urethane adhesive.
12. An ink-jet printer cartridge body comprising:
- an ink reservoir chamber;
  - an exit port;
  - an ink flow pathway interconnecting said ink reservoir chamber to said exit port, said ink flow pathway including a duct;
  - an opening extending from said duct to an outer surface of said ink-jet cartridge body; and
  - a sealant plug formed in situ in said opening.
13. An ink-jet printer cartridge body as claimed in claim 12 wherein said opening has a defined volume and said sealant plug is formed by a volume of sealant substantially equal to said defined volume.
14. An ink-jet printer cartridge body as claimed in claim 12 wherein said opening has a defined volume and said plug is formed by a volume of sealant sufficient to substantially fill said defined volume, a surface of said plug forming a portion of said ink flow pathway.
15. An ink-jet printer cartridge body as claimed in claim 12 wherein said opening has a defined volume and said plug is formed by a volume of sealant sufficient to substantially fill said defined volume, said plug forming a junction portion of said ink flow pathway surrounding said plug.
16. An ink-jet printer cartridge body as claimed in claim 12 wherein said chamber is filled with ink.
17. An ink-jet printer cartridge body as claimed in claim 12 wherein said chamber may be refilled with ink.
18. A method for making an ink jet printer cartridge comprising the steps of:
- molding an ink jet cartridge body using a mold having a core pin for forming a duct of an ink flow pathway within said body;
  - withdrawing said core pin through an opening extending from said duct to an outer surface of said ink jet cartridge body to open said duct; and
  - closing said opening by injecting a sealant into said opening.
19. A method for making an ink jet printer cartridge as claimed in claim 18 wherein said opening has a defined volume and said step of closing said opening comprises the step of injecting a volume of sealant substantially equal to said defined volume.
20. A method for making an ink jet printer cartridge comprising the steps of:
- molding an ink jet cartridge body using a mold having a core pin for forming a duct of an ink flow pathway within said body;
  - withdrawing said core pin through an opening extending from said duct to an outer surface of said ink jet cartridge body to open said duct; and
  - injecting a sealant into said opening to frictionlessly close said opening.
21. A method for making an ink jet printer cartridge as claimed in claim 20 wherein said step of injecting a sealant into said opening to frictionlessly close said opening comprises the step of entrapping microscopic flash within said opening.
22. A method for making an ink jet printer cartridge as claimed in claim 20 wherein said opening has a defined volume and said step of injecting a sealant into said opening comprises injecting a volume of sealant sufficient to substantially fill said defined volume and form a junction within said ink flow pathway and surrounding said opening.
23. A method for making an ink jet printer cartridge comprising the steps of:
- molding an ink jet cartridge body using a mold having a core pin for forming a duct of an ink flow pathway within said body;
  - withdrawing said core pin through an opening extending from said duct to an outer surface of said ink jet cartridge body; and
  - injecting a quantity of sealant sufficient to substantially fill said opening.

Fig. 1

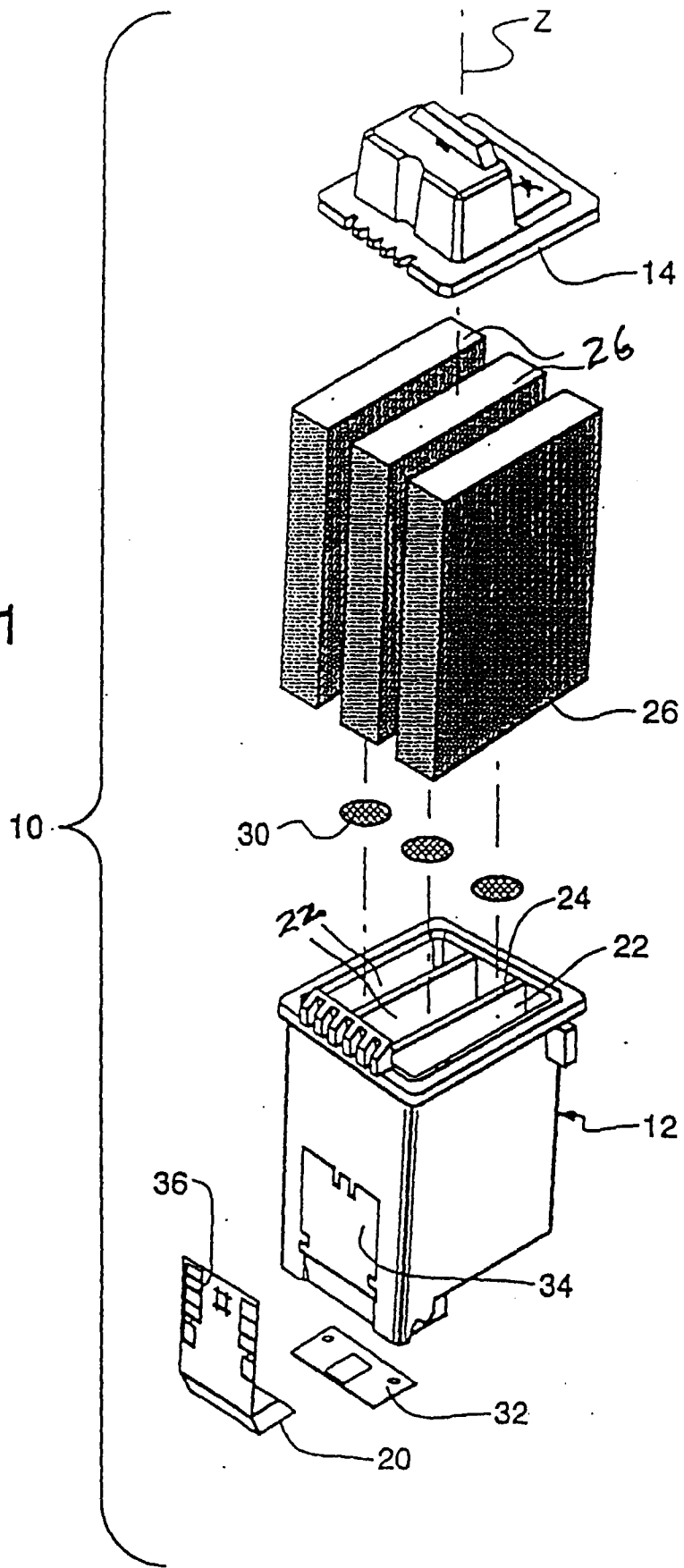


Fig. 2

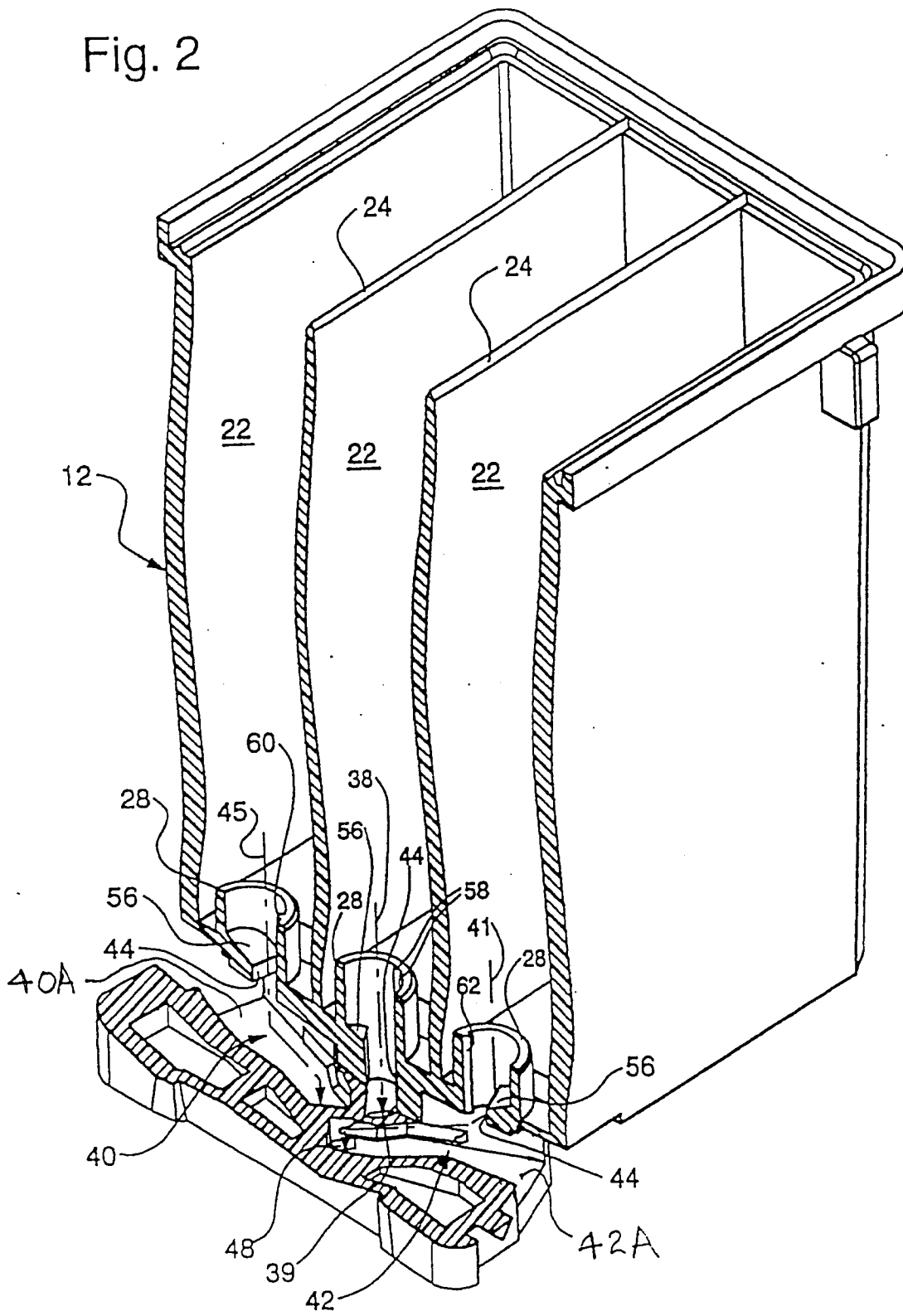
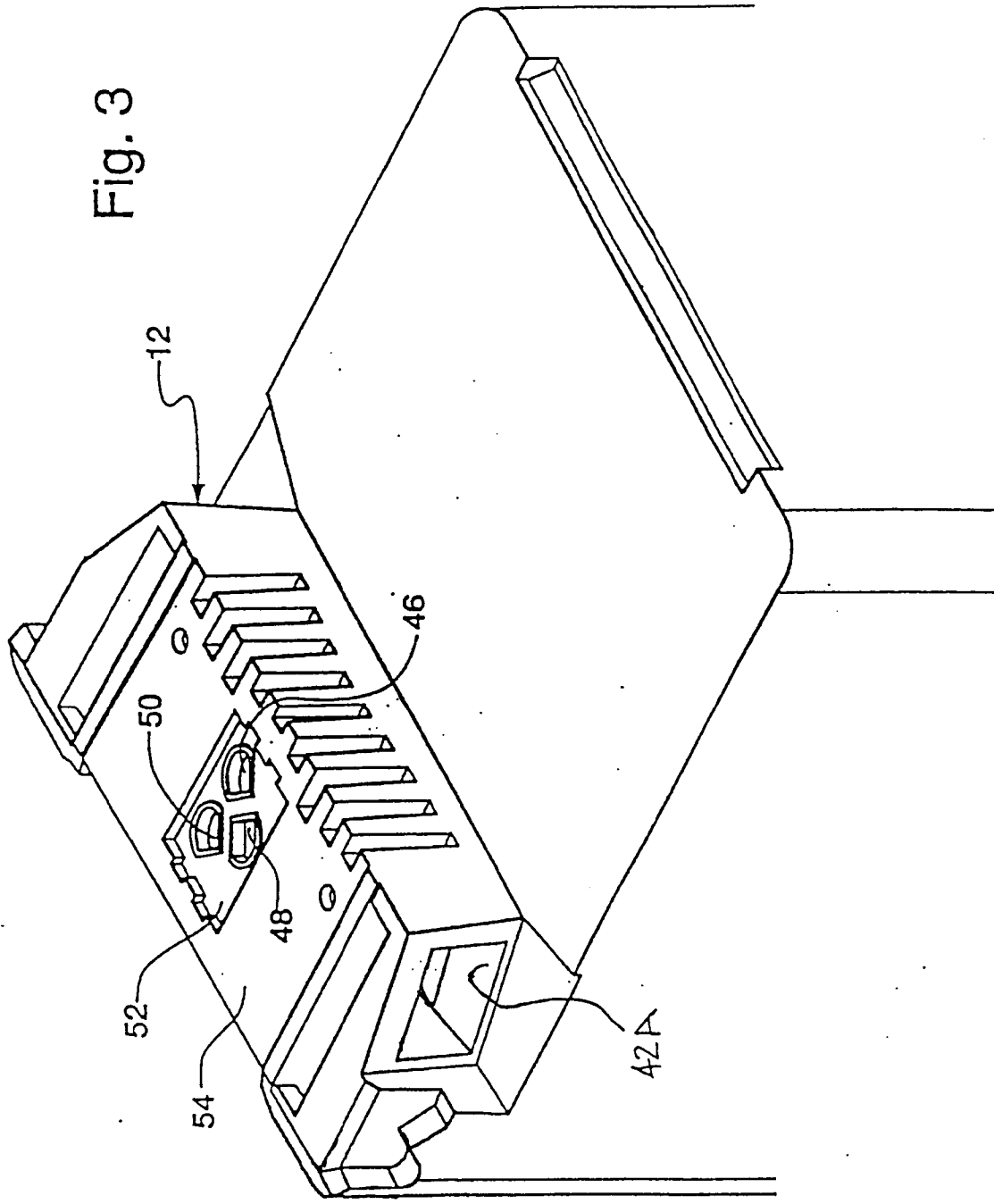


Fig. 3





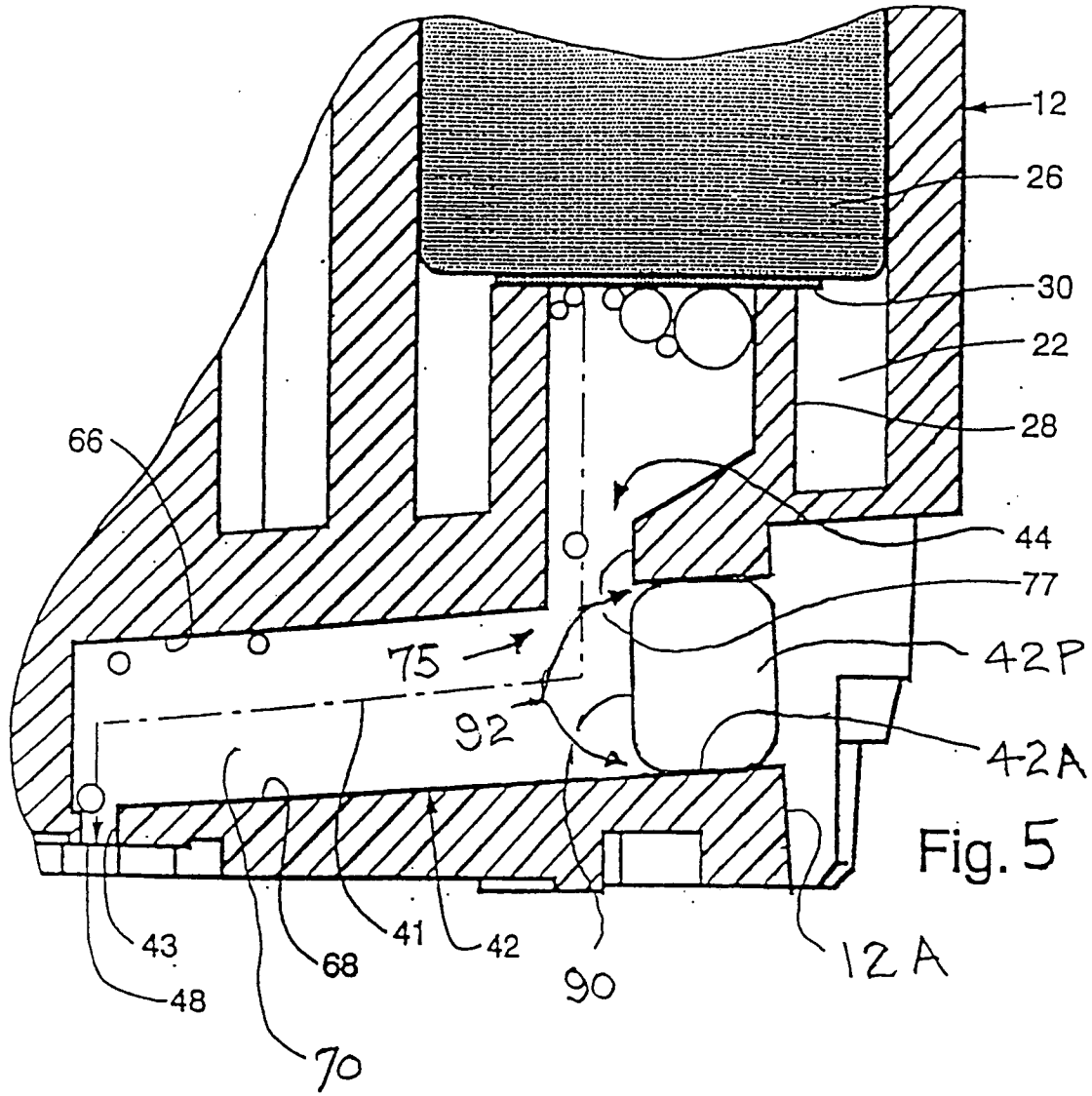


Fig. 5