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YAN

(54) **EXTERNAL INK SUPPLY AND BALANCING SYSTEM FOR INKJET PRINTER**

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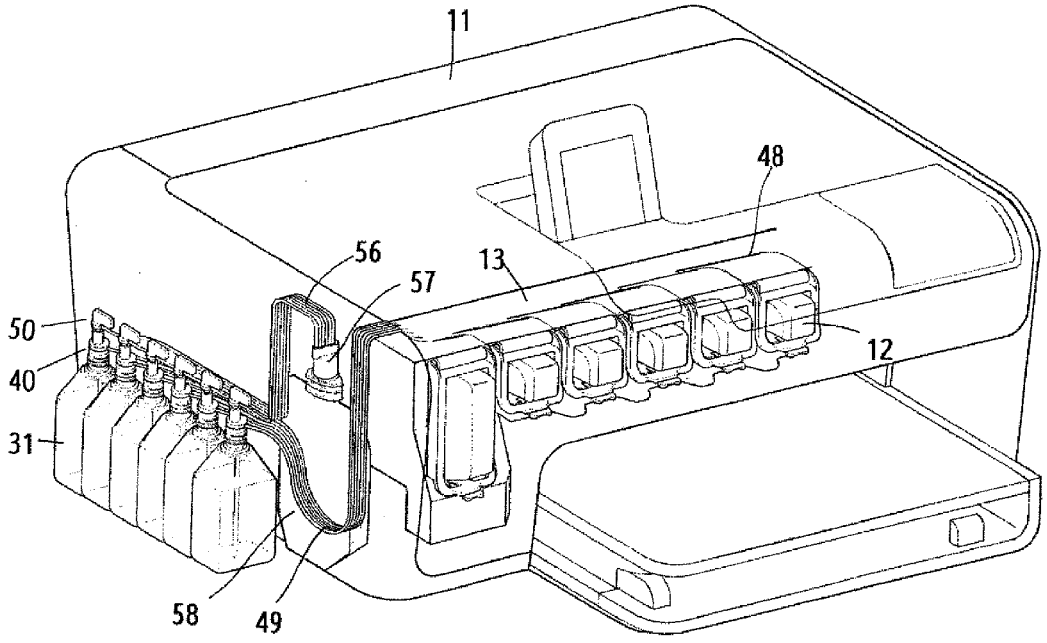
(57) **ABSTRACT**

An external ink supply and balancing system for inkjet printer, which mainly comprises a reflow system of each ink container of an inkjet printer be blocked and to have each ink container be connected to a respective external ink bottle through a respective L-shaped connector and flexible ink supply tube and also to be an air bag connected to an air discharge connector at each ink bottle through a flexible tube for collecting exhaust air so that when the inkjet printer runs an ink circulation flow, the ink bottles supply inks to the respective ink containers and guide exhaust air out of the ink containers to the air bag.



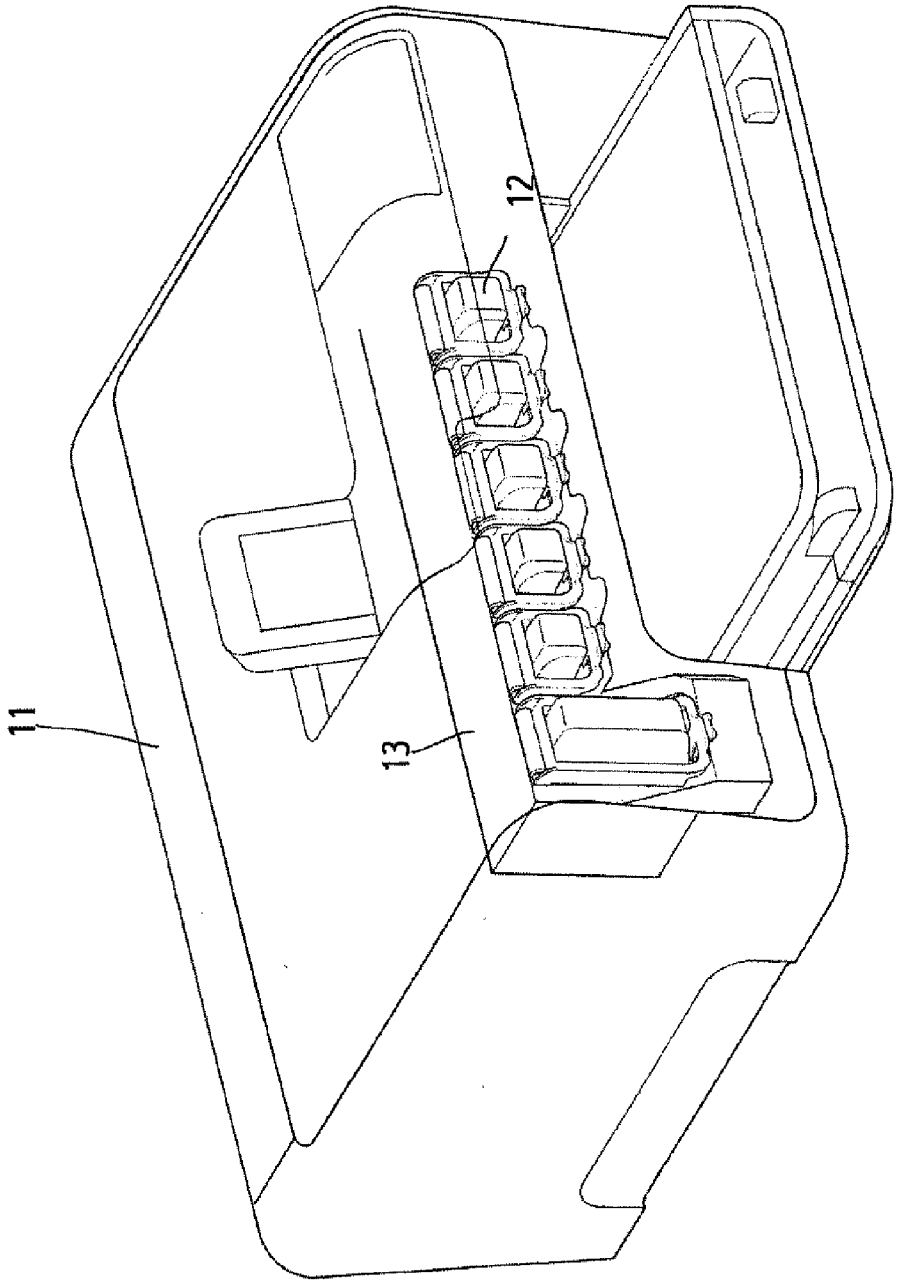


FIG. 1
(Prior Art)

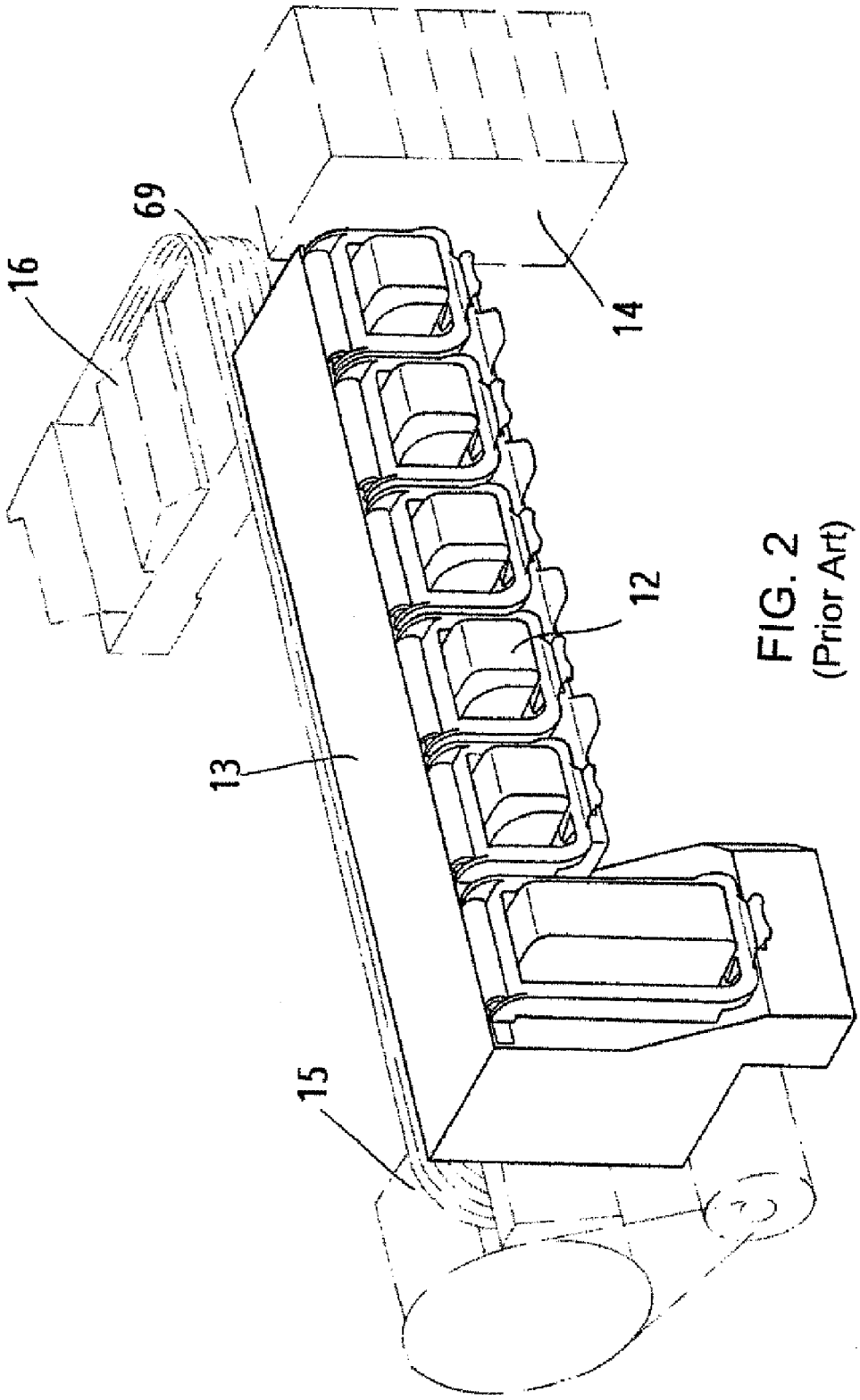


FIG. 2
(Prior Art)

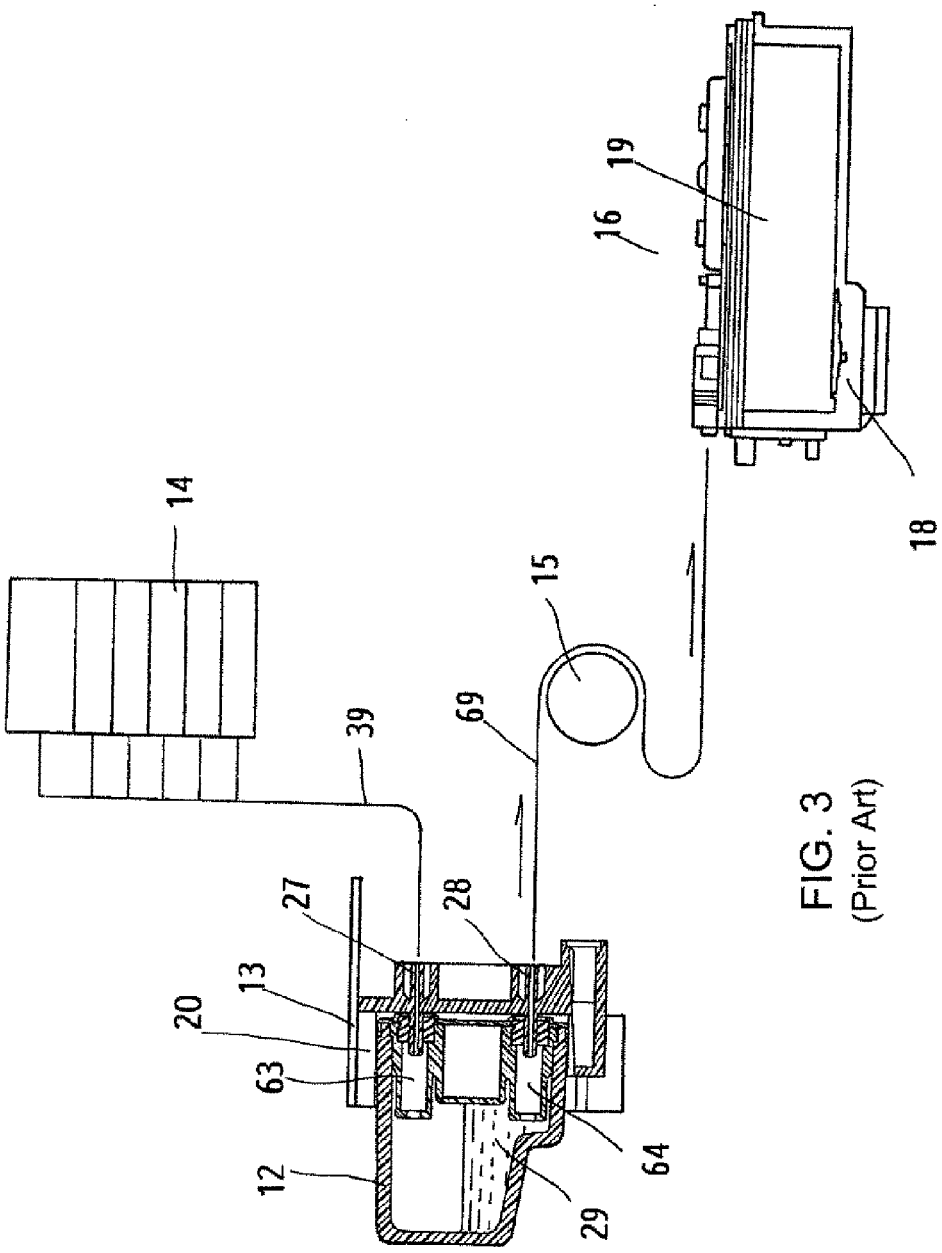


FIG. 3
(Prior Art)

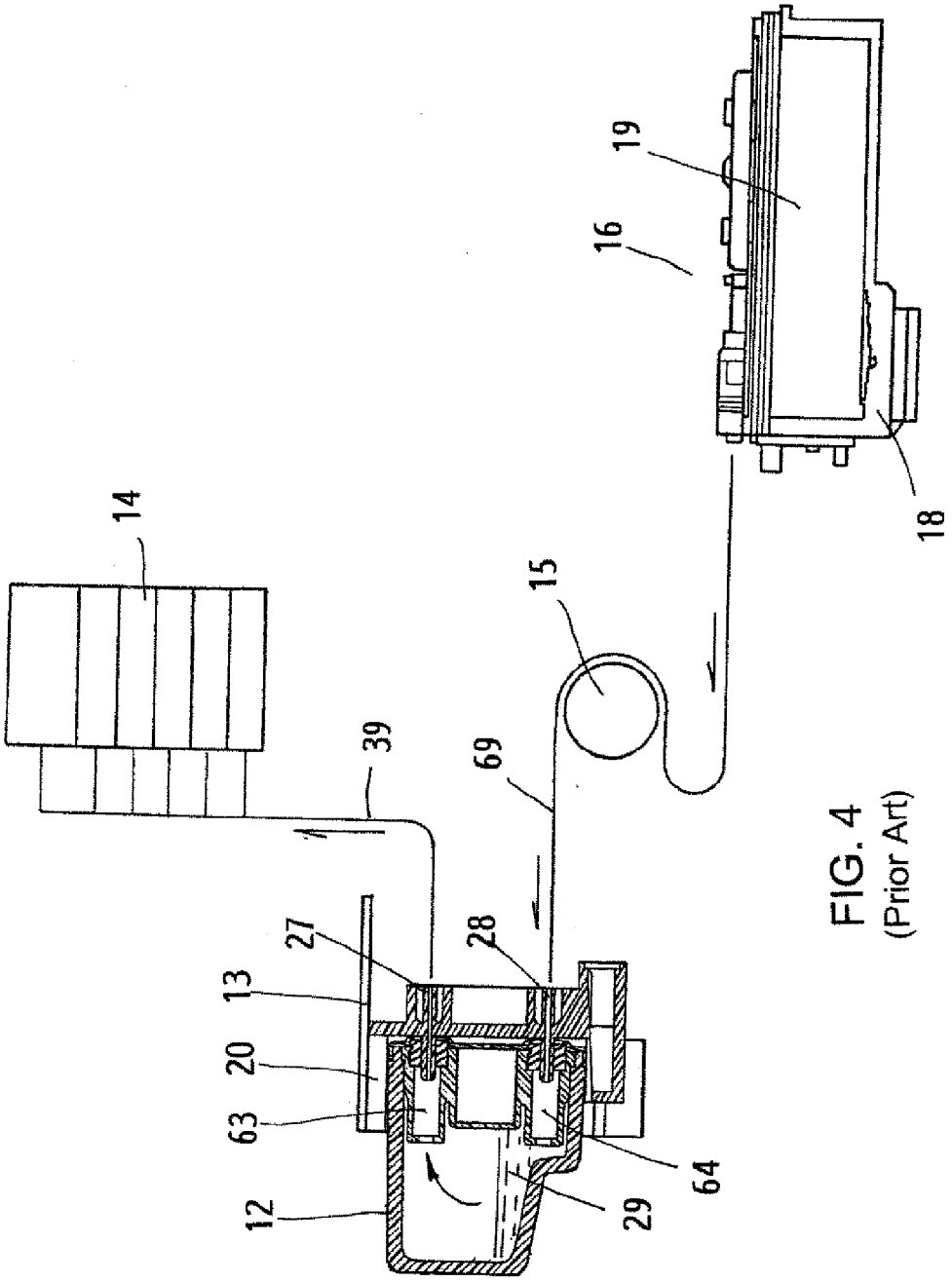


FIG. 4
(Prior Art)

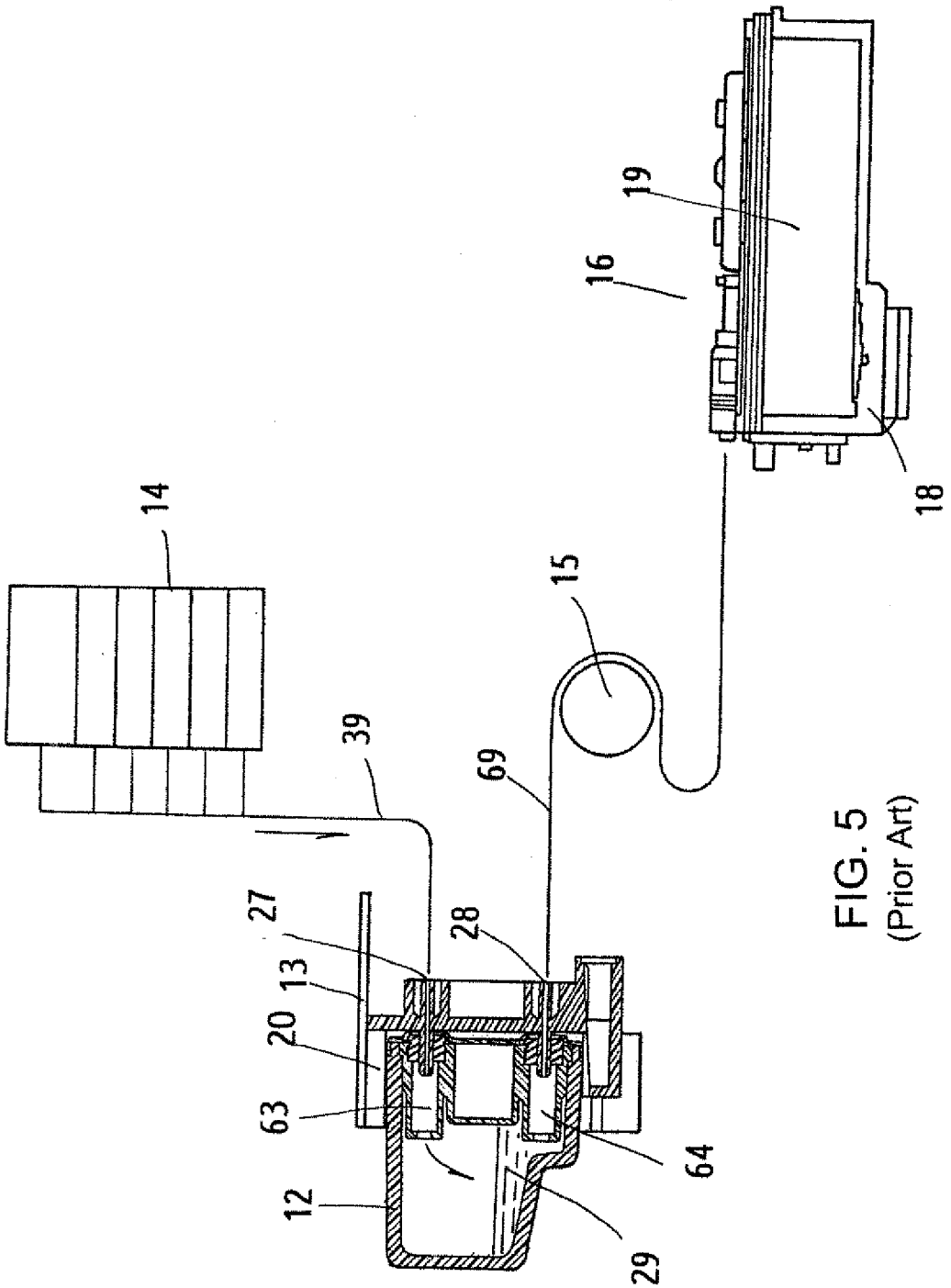


FIG. 5
(Prior Art)

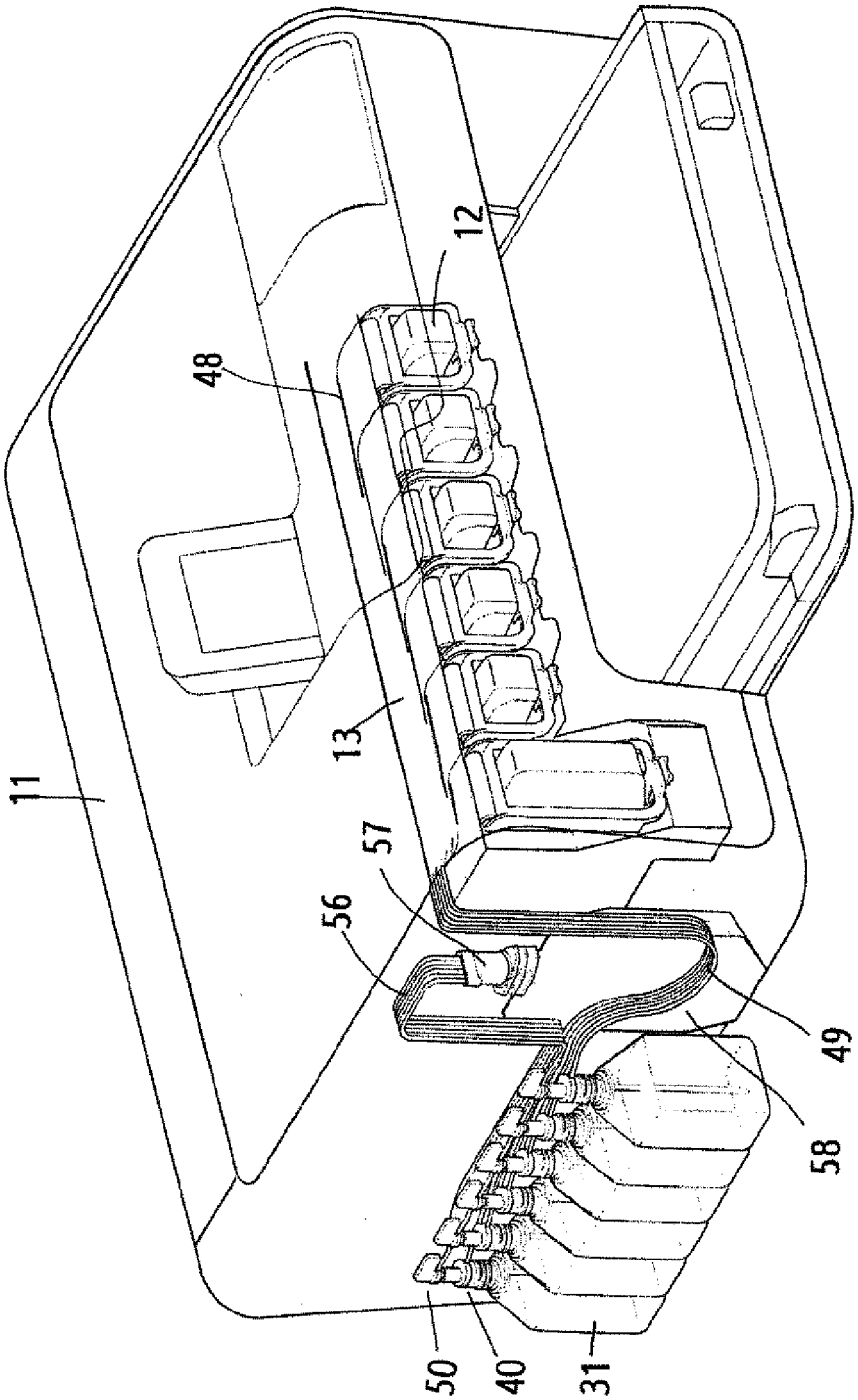


FIG. 6

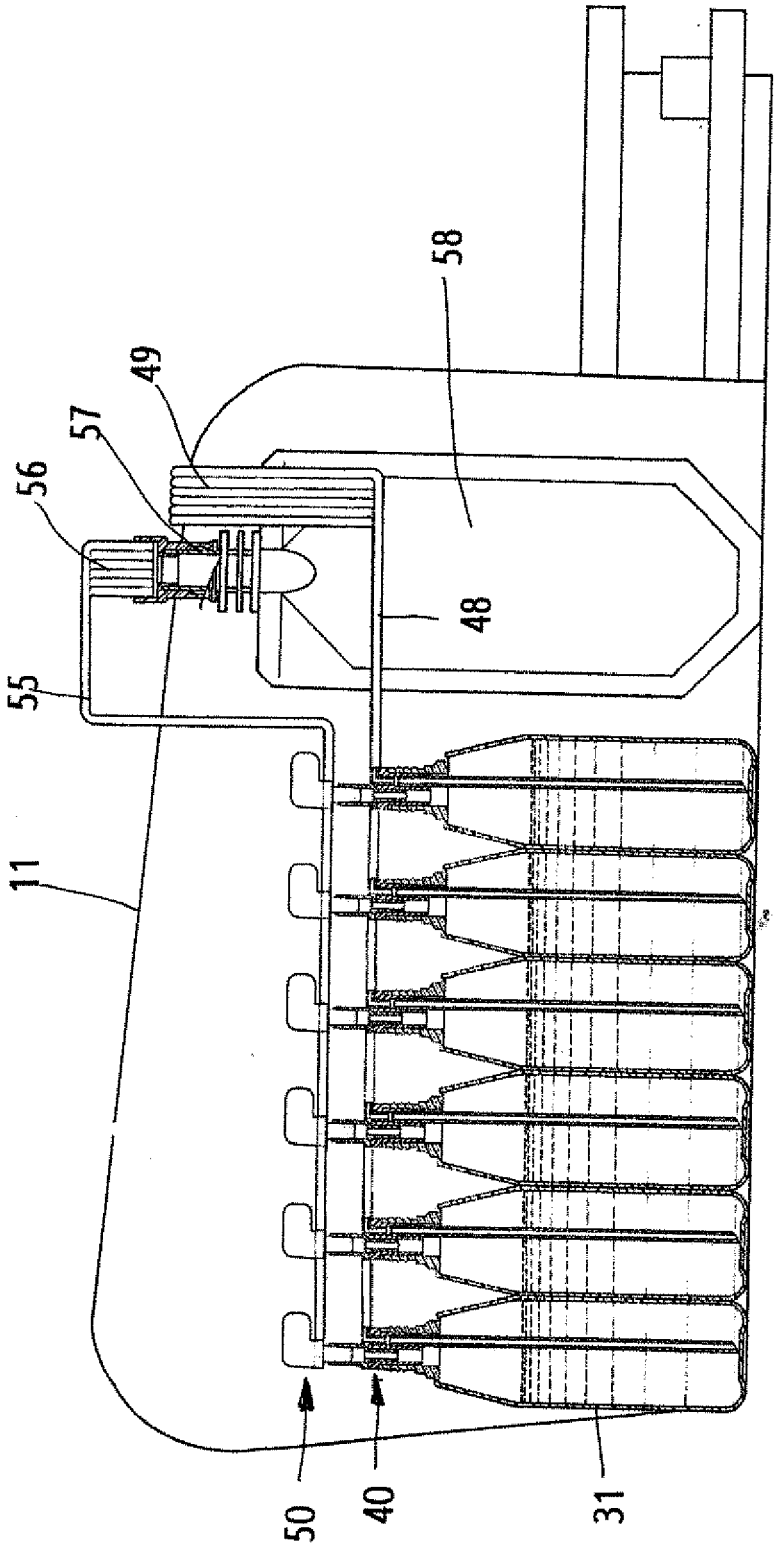


FIG. 7

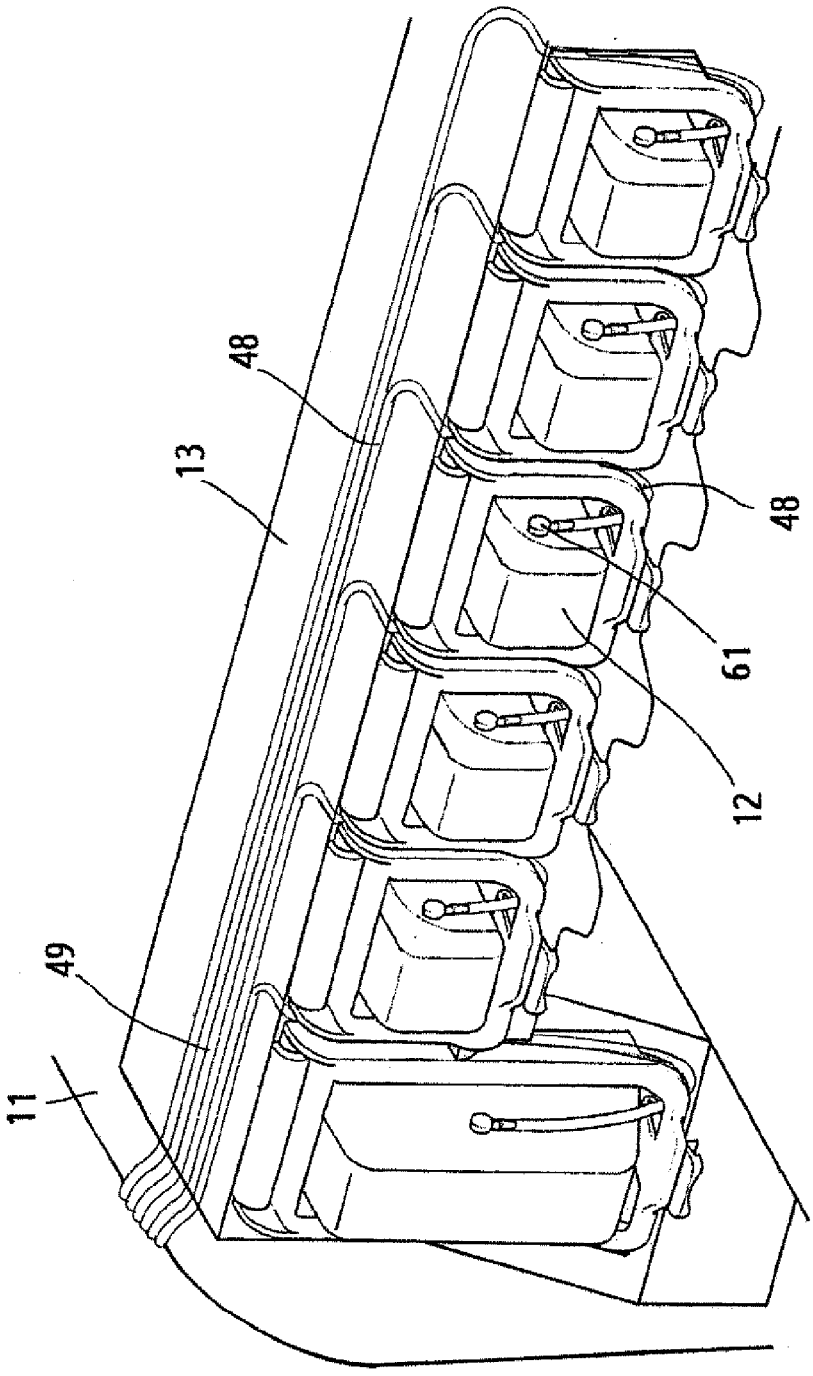


FIG. 8

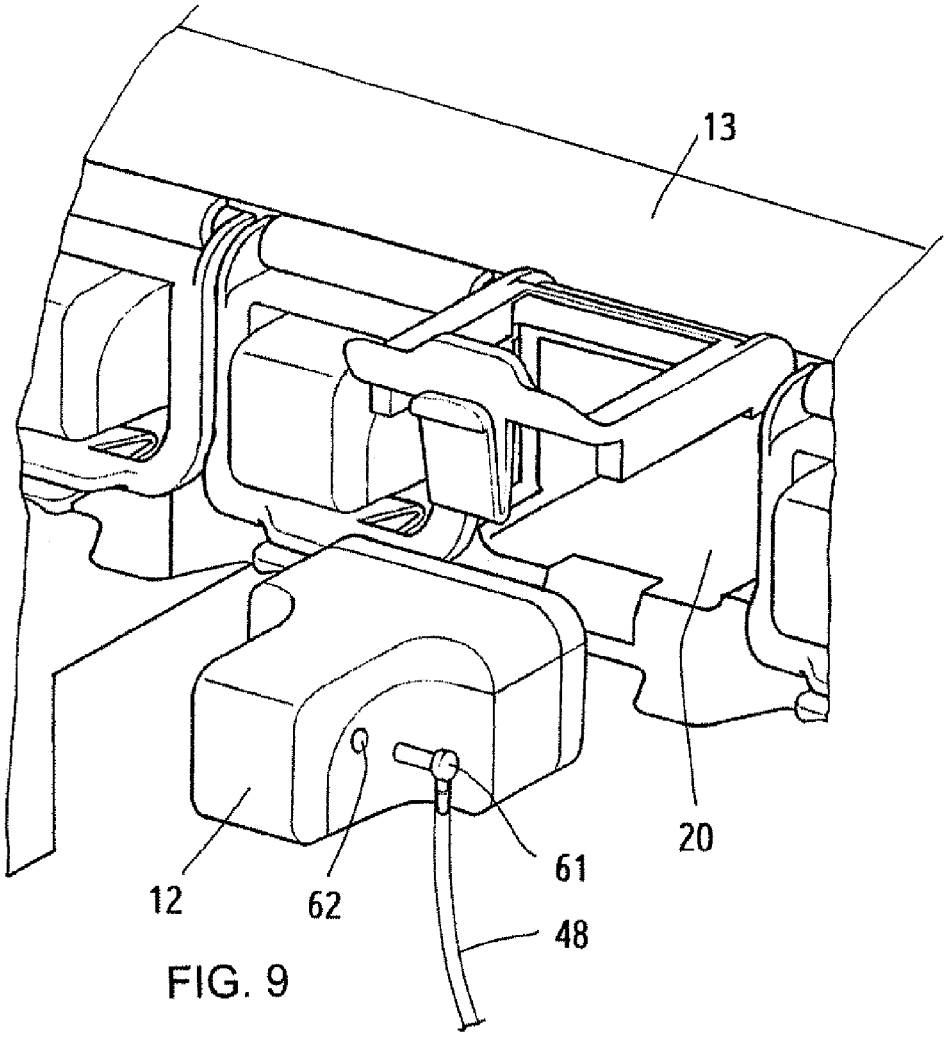


FIG. 9

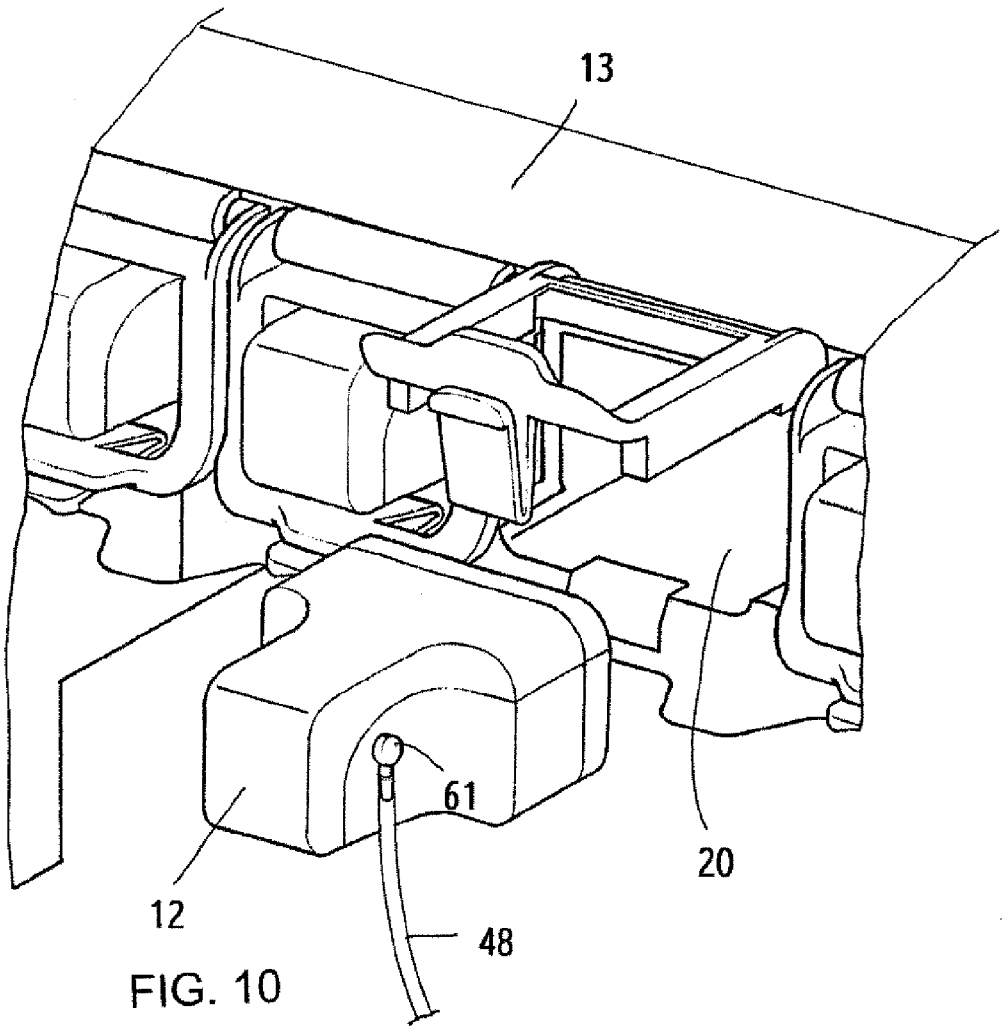


FIG. 10

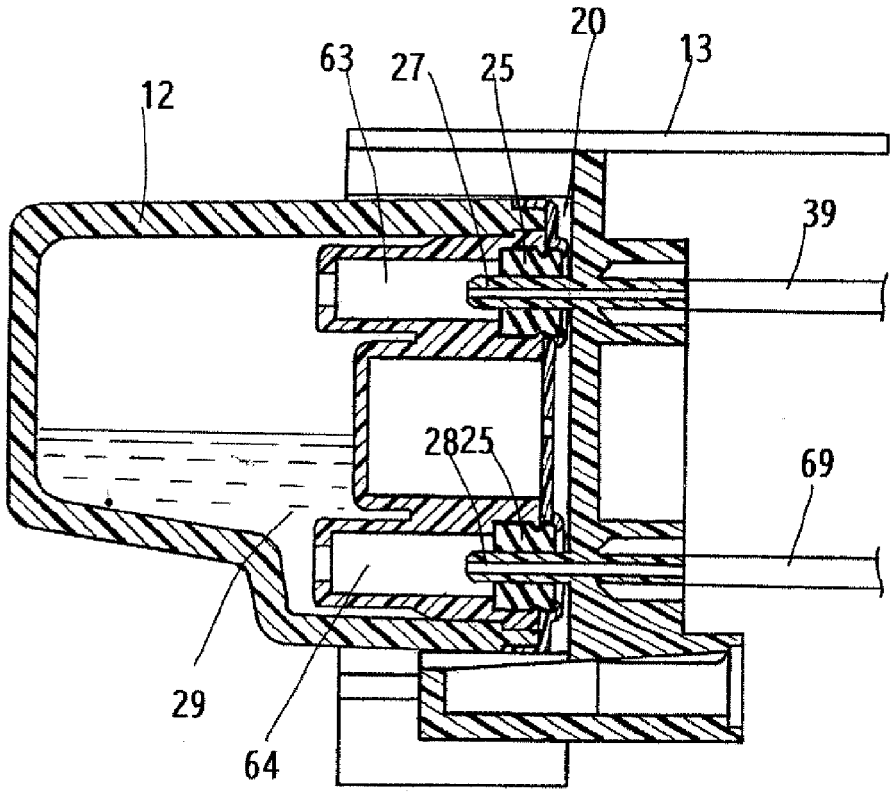


FIG. 11
(Prior Art)

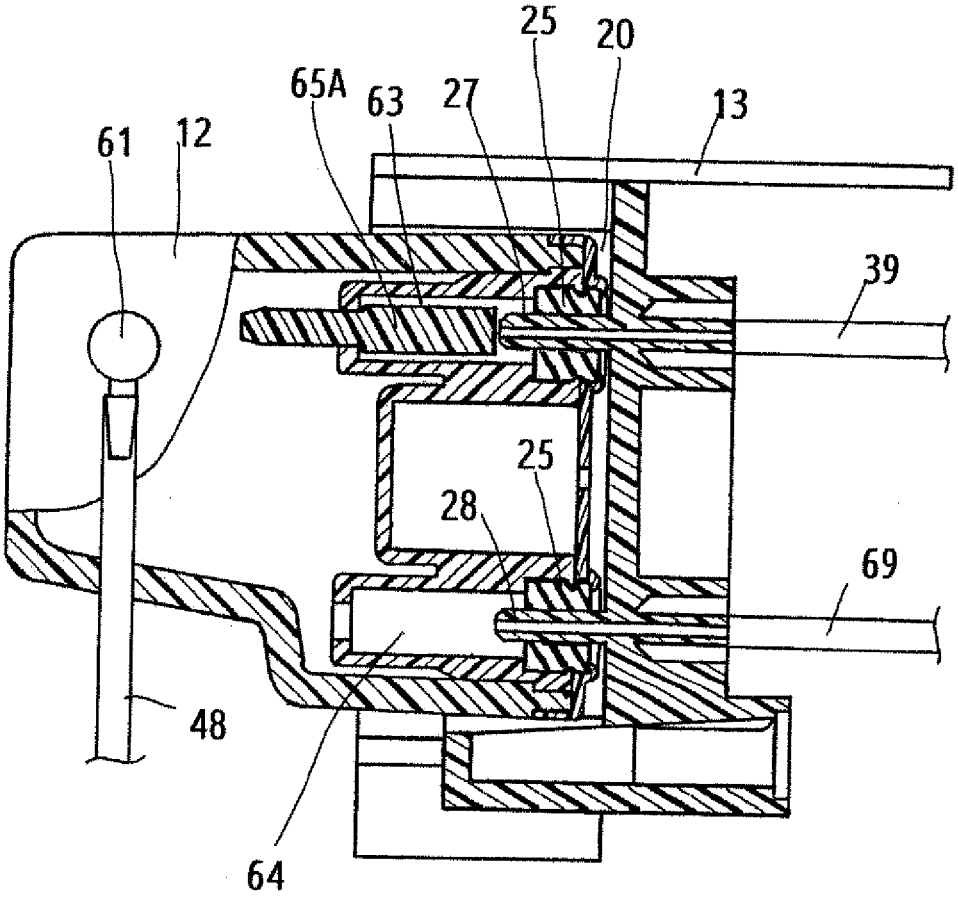


FIG. 12

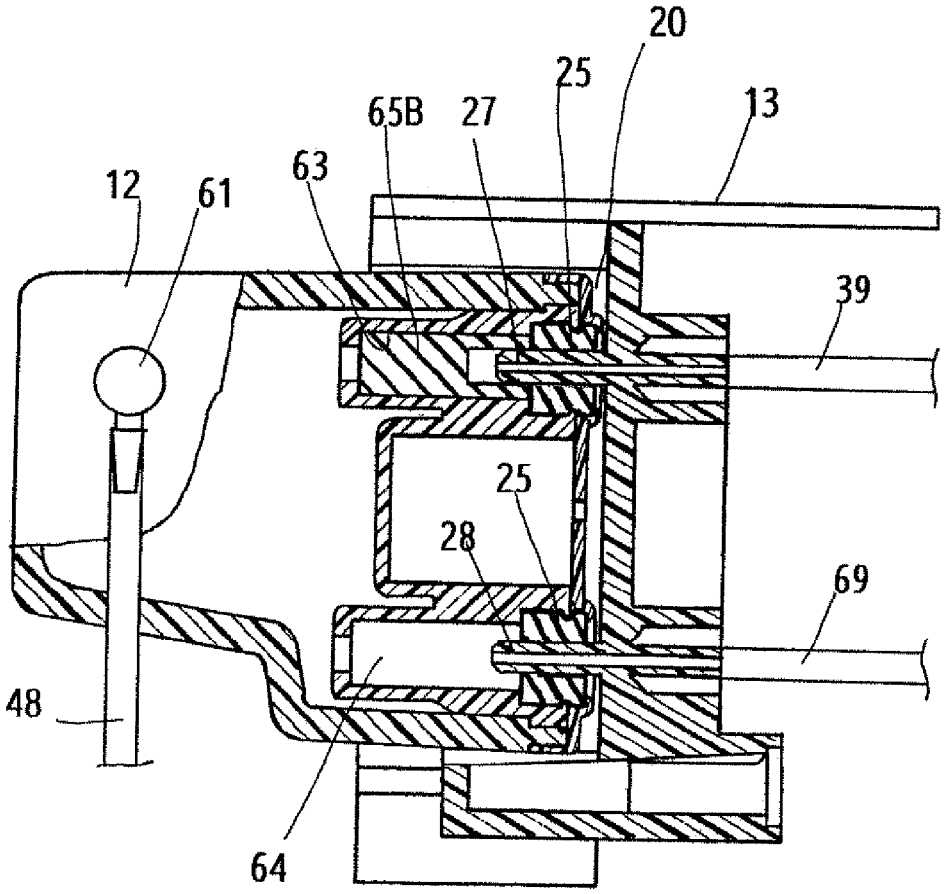


FIG. 13

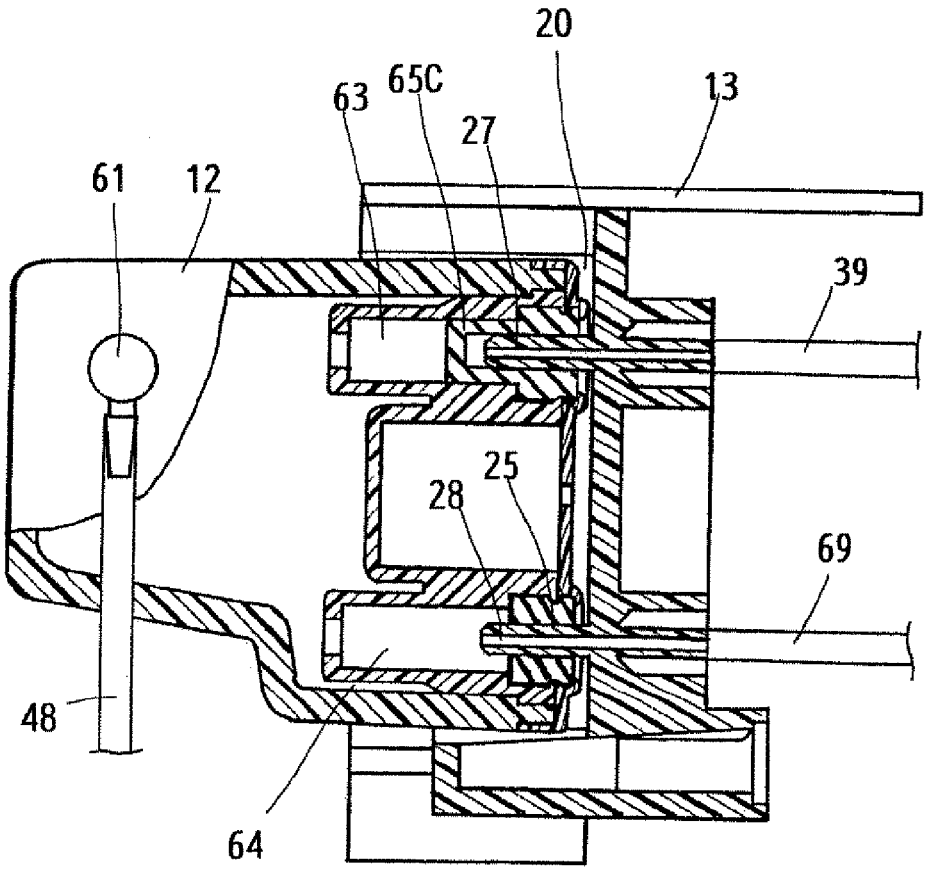


FIG. 14

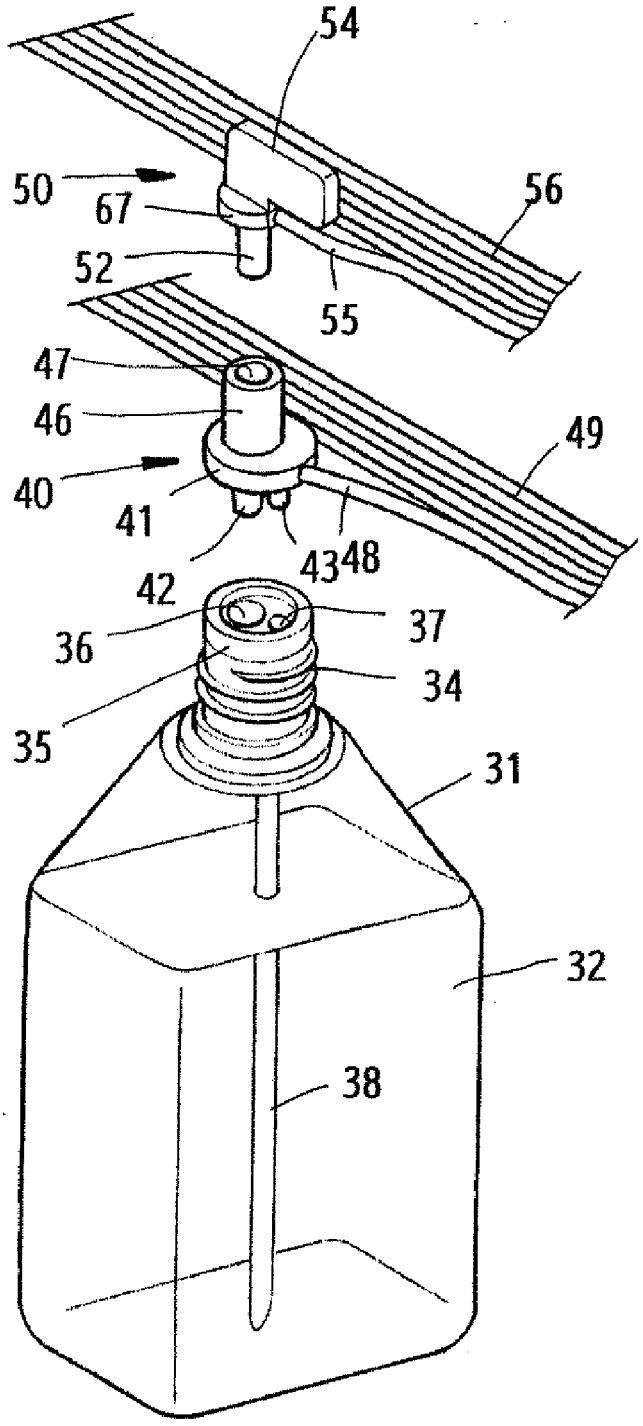


FIG. 15

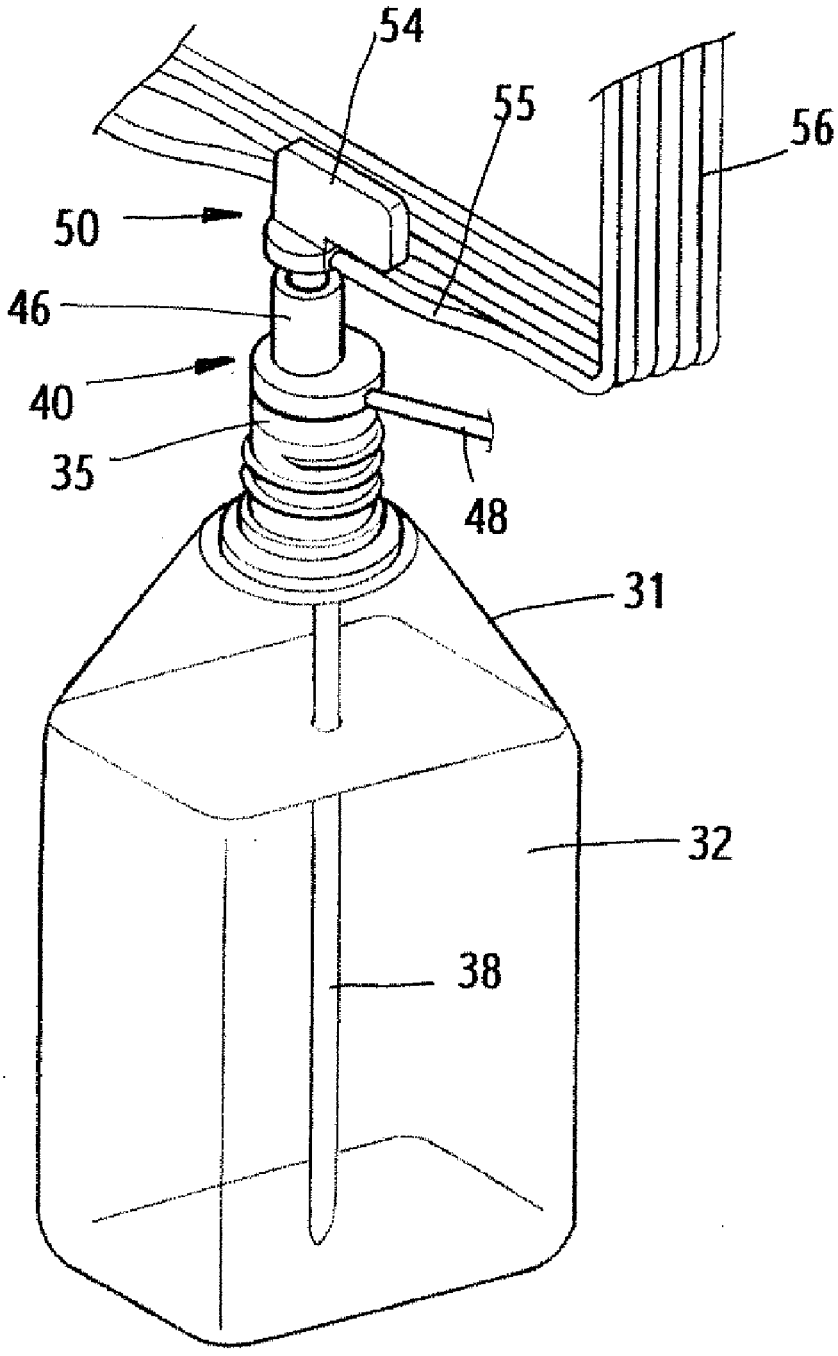


FIG. 16

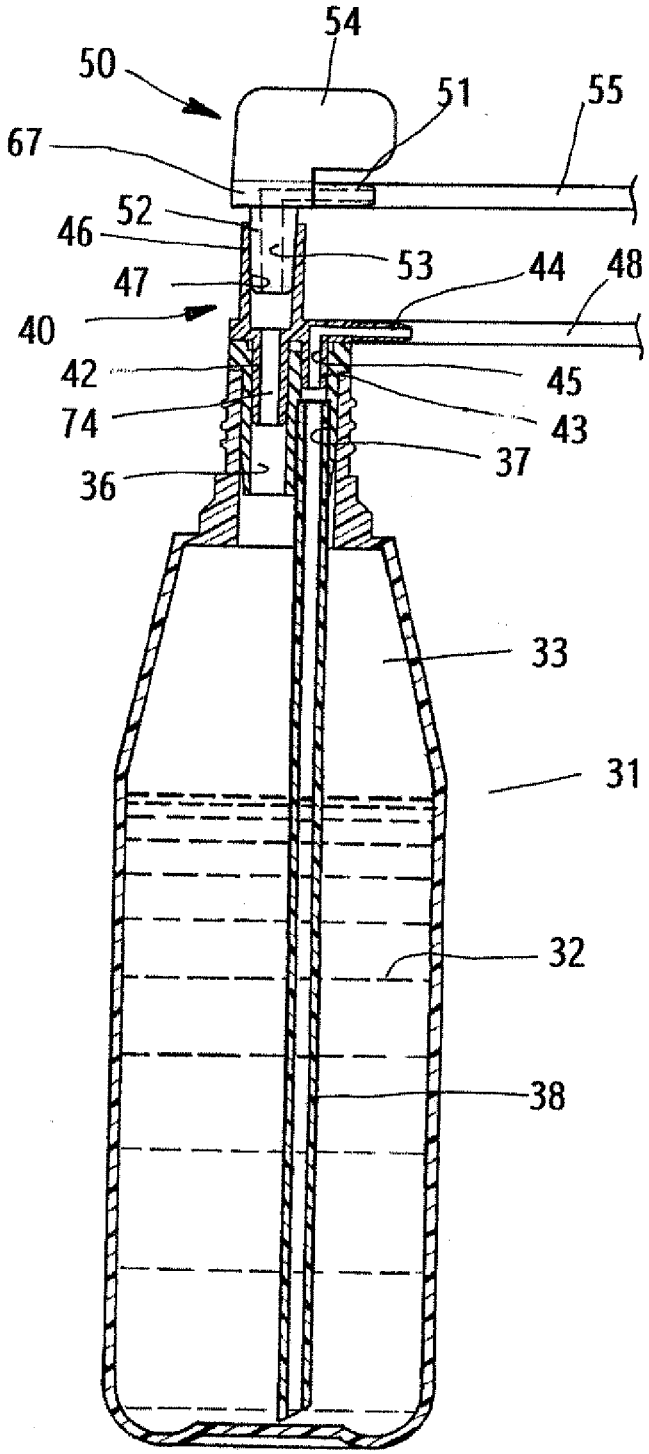


FIG. 17

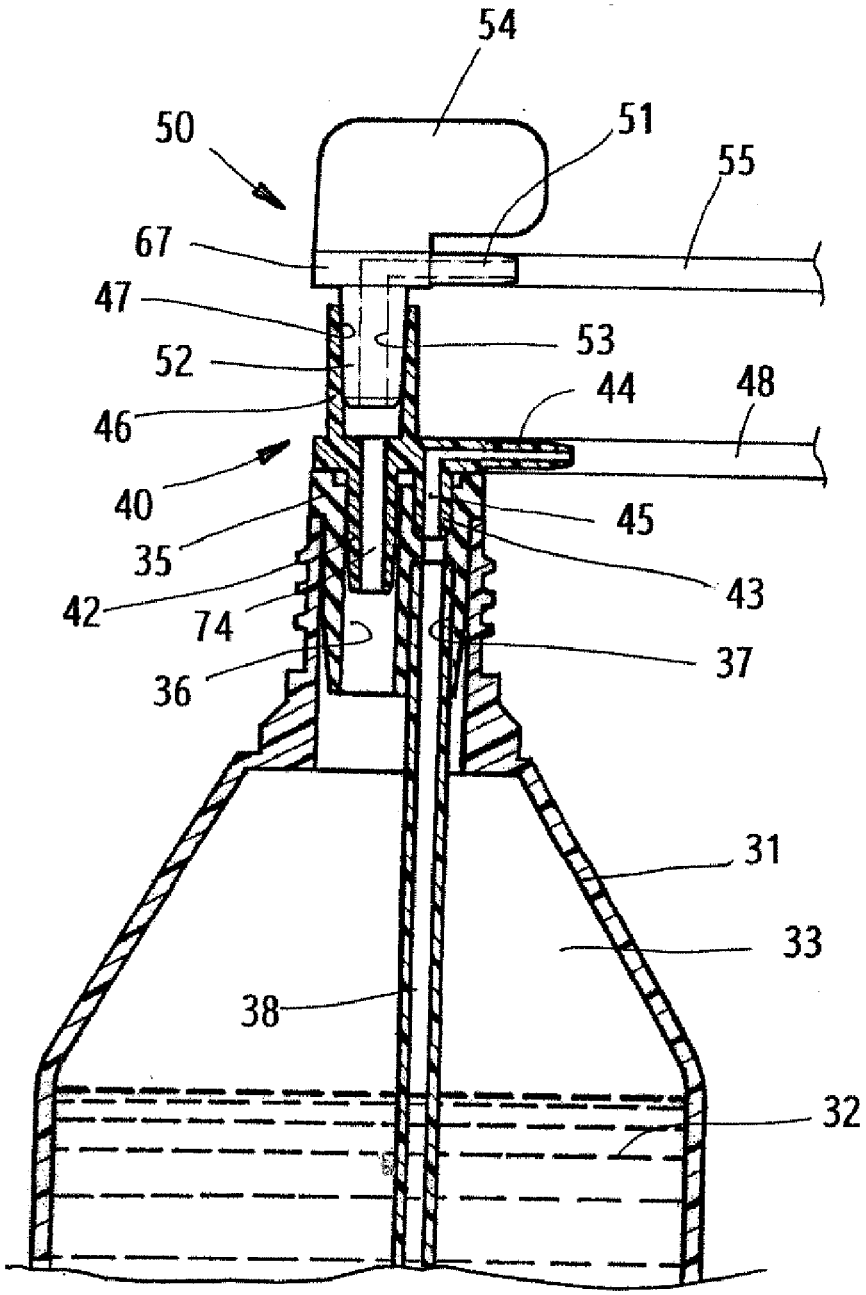


FIG. 18

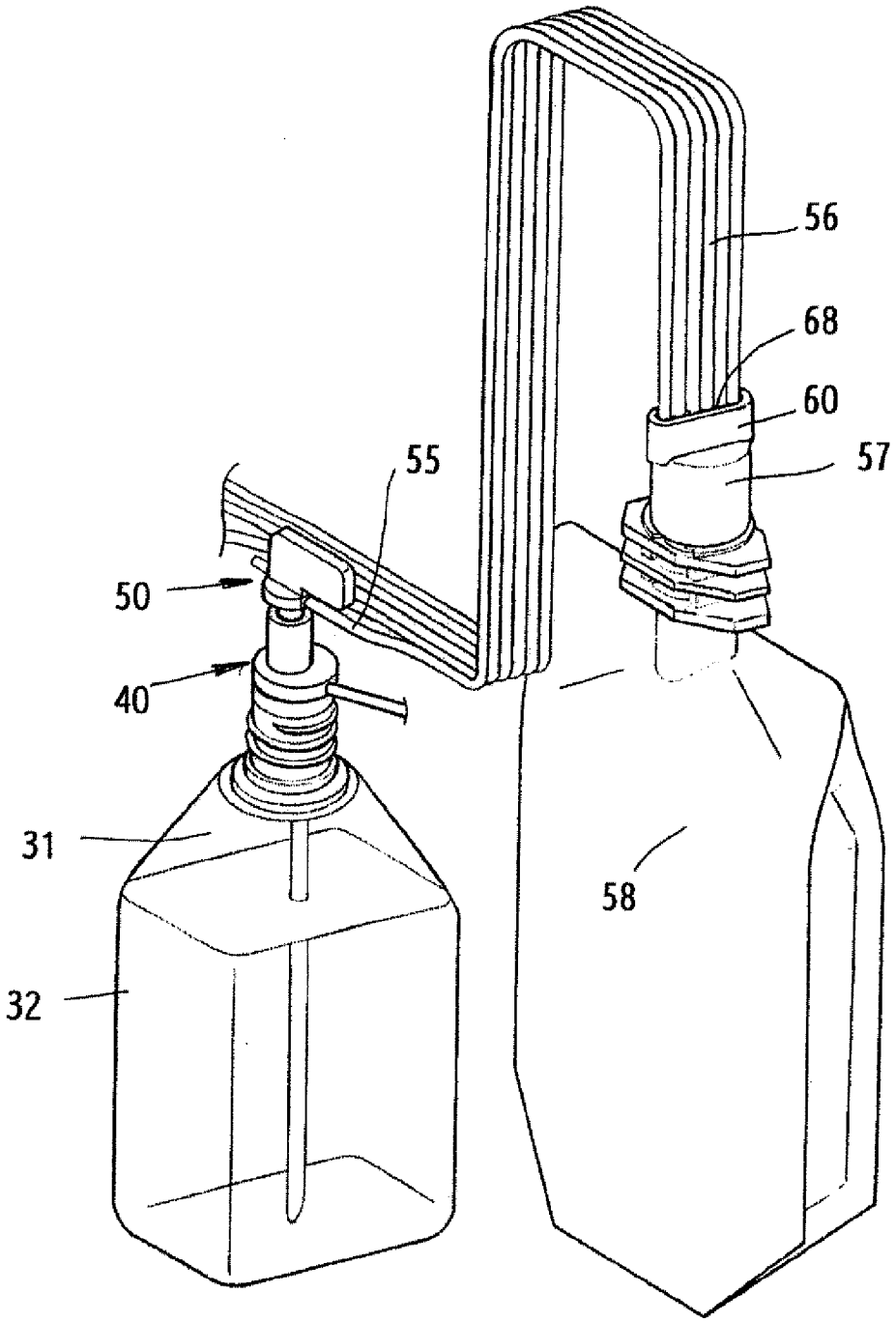


FIG. 19

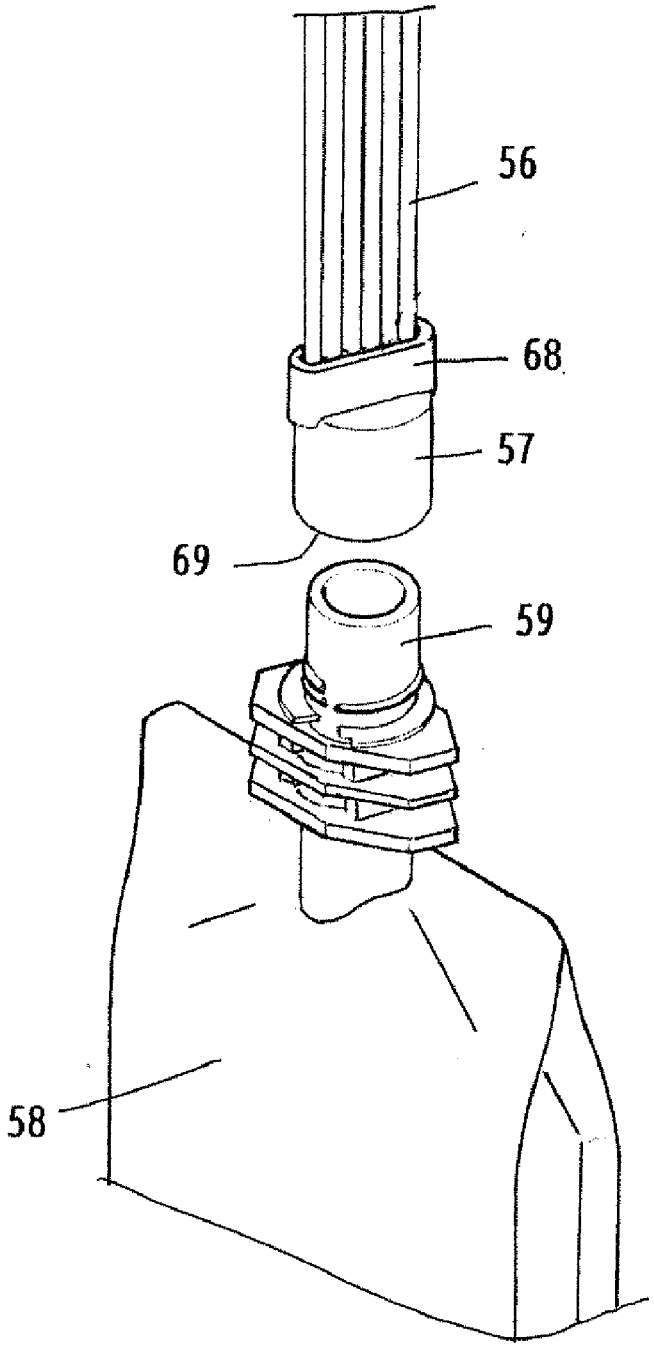


FIG. 20

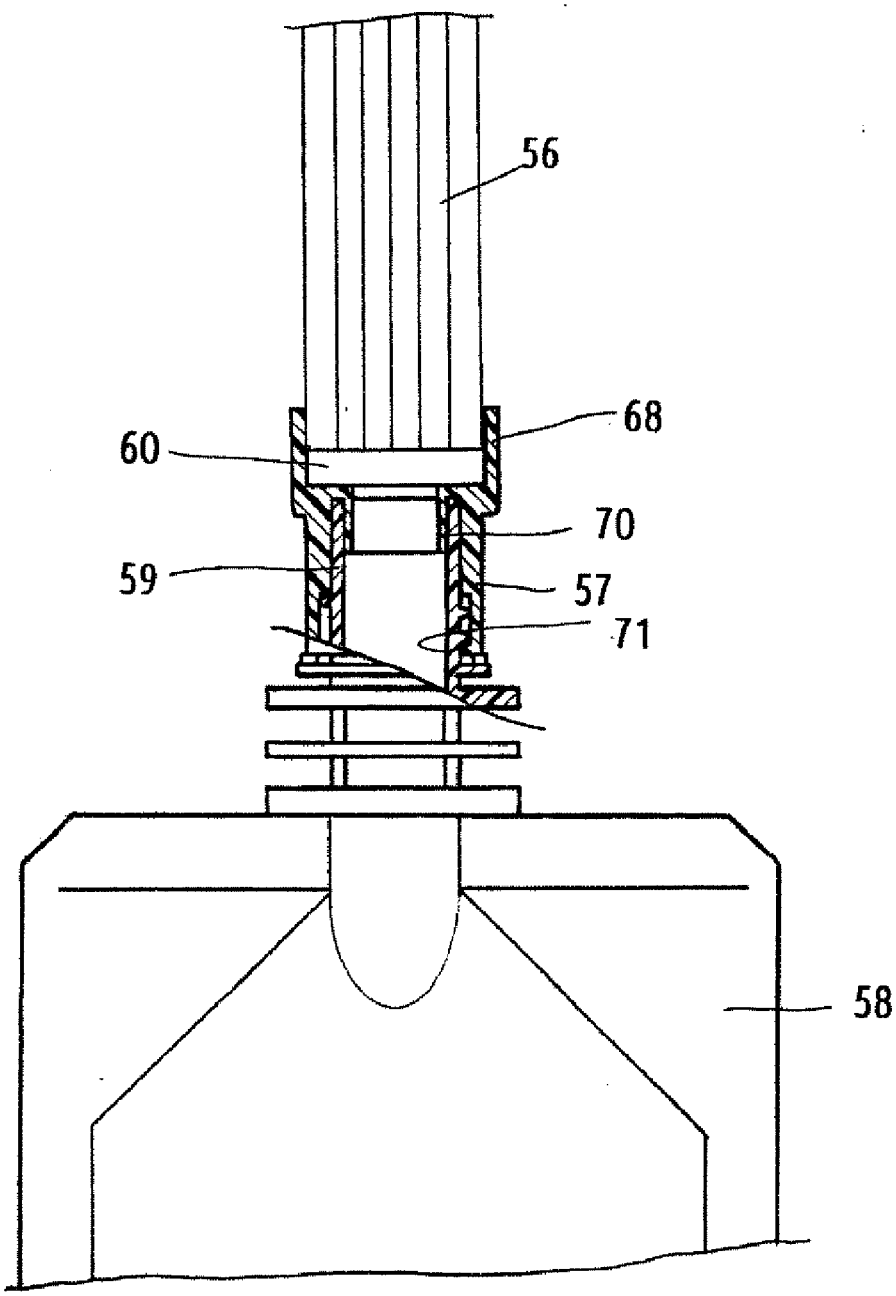


FIG. 21

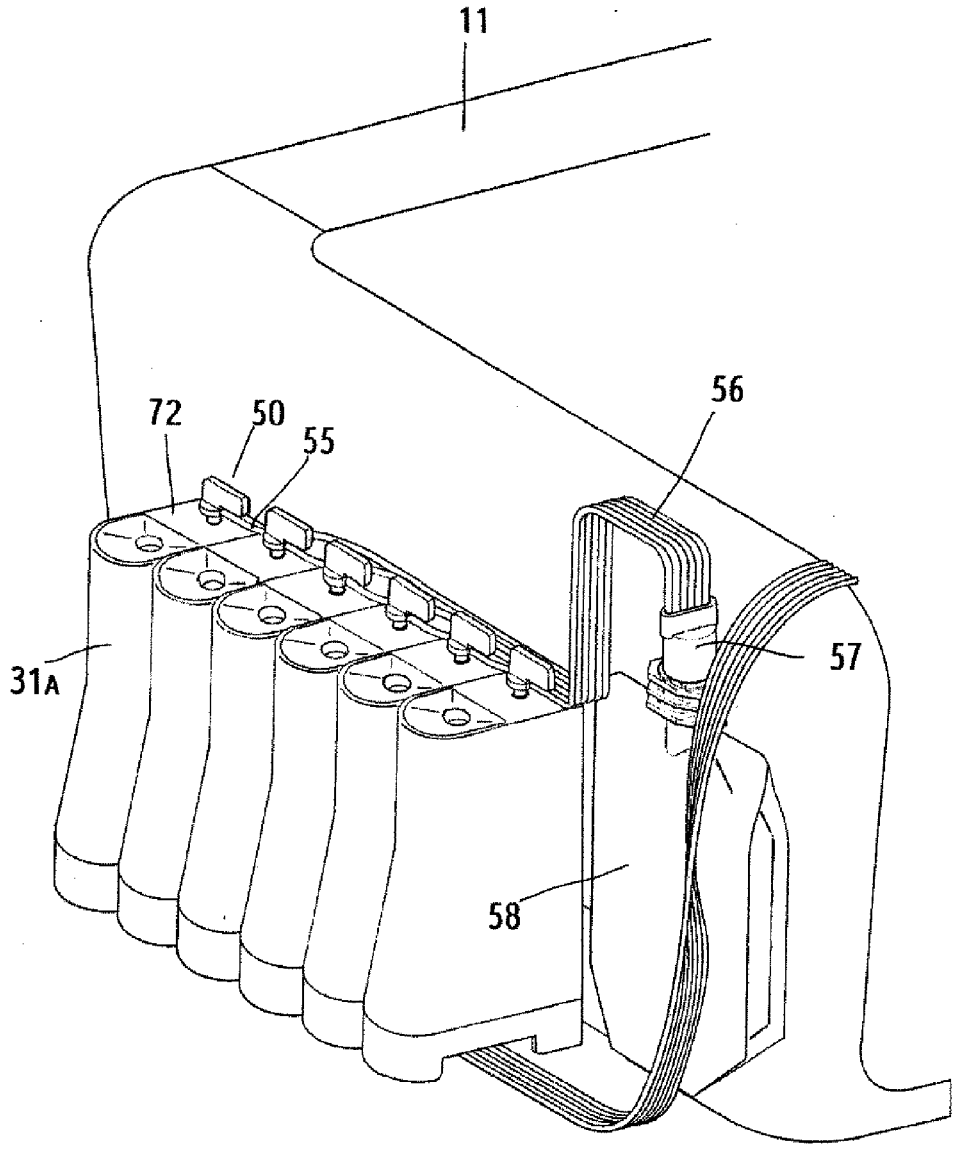


FIG. 22

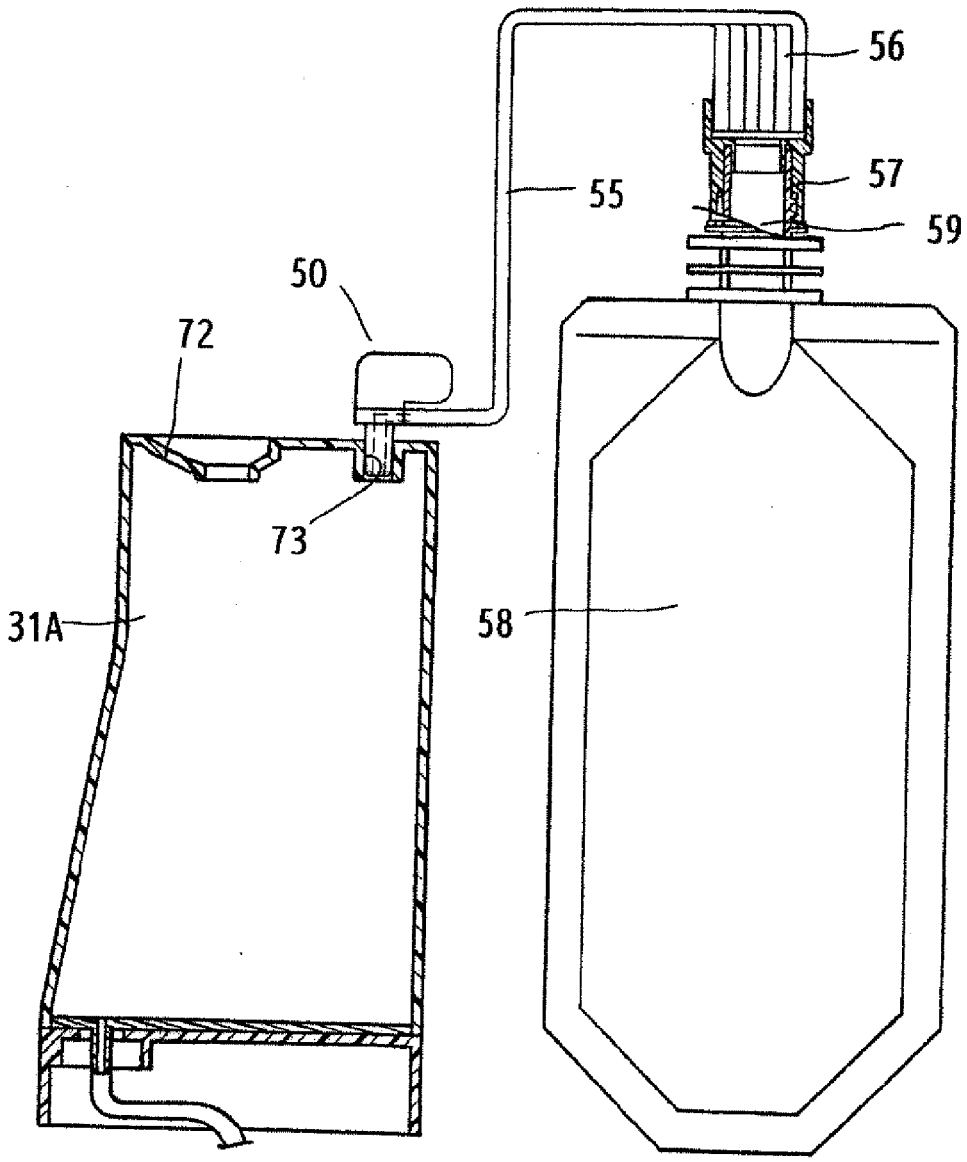


FIG. 23

EXTERNAL INK SUPPLY AND BALANCING SYSTEM FOR INKJET PRINTER

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to an ink supply system for inkjet printer, and particularly to an external ink supply and balancing system for inkjet printer.

[0003] 2. Description of the Prior Art

[0004] In the conventional inkjet print commonly have an Active Air Management, the Active air management has a pump set between the printing-fluid delivery system and the ink containers and a plurality of flexible tubes respectively connected between the ink containers and respective vent chambers. During the first use of a new inkjet printer of the aforesaid design to run an ink circulation flow, the pump pumps the ink from each ink container into the ink chamber of the printing-fluid delivery system, till that the corresponding ink chamber and printer head have been fully filled with the respective ink. Following the operation of the inkjet printer and consumption of the ink of each ink container, air enters each respective ink chamber to balance the pressure. When the ink in one ink chamber of the printing-fluid delivery system dropped below a predetermined low level, a demand signal is produced, causing the pump to start the ink supply flow again. At this time, the pump pumps air out of the printer head at first, and then pumps the ink from the respective ink container into the respective ink chamber of the printing-fluid delivery system. This circulation is repeated two or three times till that the respective ink chamber of the printing-fluid delivery system is fully filled up with the respective ink for printing. Before a new supply of the ink from one ink container to the printing-fluid delivery system, the exhaust air goes from the printer head through the ink in the respective container toward the respect vent chamber. When a flow of exhaust air goes through the ink in one ink container, the ink in the respective ink container is caused to produce ink bubbles that move with the flow of exhaust air to the respective vent chamber. When ink bubbles entered the vent chamber, they pop within a short period and convert into water-like ink, and water-like ink thus produced immediately flows back from the vent chamber to the respective ink container for further supply to the printing-fluid delivery system for printing.

[0005] The capacity of the ink containers of an inkjet printer of the aforesaid design is limited. When heavy printing is required, the cost of the original ink container system is high.

[0006] In a conventional available supplementary ink supply systems for use with an inkjet printer to lower the printing cost. According to one supplementary ink supply system, a connector is attached to each ink container, and then a flexible tube is used to connect respective external ink reservoirs to the connectors at the ink containers. During an ink supply flow, the ink in each external ink reservoir has a pressure that prohibits exhaust of air out of the inkjet printer, and therefore exhaust air is kept in the vent chambers of the inkjet printer, limiting the ink supply capacity of the external ink reservoirs.

[0007] In another supplementary ink supply system, substitute ink containers are mounted in the holder of the inkjet printer. Each substitute ink container has a connector connected to the pump of the inkjet printer and an external part connected to an external ink bottle through a respective flexible tube. According to this arrangement, the external ink bottles are spaced from the pump at a distance. When the pump is started to pump one ink into the printing-fluid delivery system after exhaust of air from the printer head, residual air in each flexible tube will be forced into the printing-fluid delivery system during forward flowing of the respective ink from the respective ink bottle through the respective substitute ink container toward the printing-fluid delivery system, resulting in formation of bubbles in the printer-head. These bubbles will affect system ink supply detection and the printing quality.

SUMMARY OF THE INVENTION

[0008] The prime object of the present invention is to provide an external ink supply and balancing system for inkjet printer, in which a proper stopper is installed in each ink container to seal the passage between each ink container and respective vent chamber in the inkjet printer, and each ink container is processed to provide a hole for the mounting of a connector so that one respective flexible ink supply tube can be attached to each ink container to connect one respective external ink bottle to each ink container. When the ink in one ink container dropped below a predetermined low level, a demand signal is produced, and the pump of the inkjet printer is started to pump air out of the ink chamber through an air passageway of the respective ink container to the corresponding external ink bottle, and then the pump is controlled to pump the ink out of the respective ink bottle through the respective ink container into the ink chamber. This procedure is repeated two or three times till that the respective ink chamber of the printing-fluid delivery system has been fully filled with the respective ink.

[0009] Another object of the present invention is to provide an external ink supply and balancing system for inkjet printer, in which the ink containers that are inserted into the holder of the inkjet printer are the originally attached ink container of the inkjet printer. This invention simply has the passage between each ink container and the respective vent chamber in the inkjet printer be sealed. Each time the ink supply flow is started, the ink in the ink container is pumped into the respective ink chamber in the printing-fluid delivery system. This ink supply flow fits the original settings of the inkjet printer, allowing air be effectively exhausted out of the ink chamber when supplying a corresponding amount of the respective ink into the respective ink chamber in the printing-fluid delivery system.

[0010] Still another object of the present invention is to provide an external ink supply and balancing system for inkjet printer, each time the ink supply flow is started, the exhaust air is guided out of the ink chamber and the respective ink container to the respective external ink bottle through one respective flexible tube, and then the ink is guided from the respective ink bottle to the respective ink container, and therefore each ink container is supplied with the respective ink when the ink level is low.

[0011] A further object of the present invention is to provide an external ink supply and balancing system for inkjet printer, in which each time the ink supply flow is started, the exhaust air is guided out of the ink chamber and the respective ink container to the respective external ink bottle through one respective flexible tube, and then exhaust air is guided through a top air discharge connector at the respective external ink bottle to an external buffering air bag via a flexible tube. Therefore, exhaust air is kept in the external air bag and will not be exhausted into the atmosphere.

[0012] A still further object of the present invention is to provide an external ink supply and balancing system for inkjet printer, in which each external ink bottle is attached with a top air discharge connector that is connected to an external air bag through a respective flexible tube. The exhaust air that is drawn out of the ink chamber and the respective ink container during an ink supply flow is guided through the respective external ink bottle toward the external air bag and then cumulated in the external air bag. Because the ink in each ink bottle is kept in an enclosed space and isolated from the atmosphere, the chemical composition of the ink will not deteriorate.

[0013] Yet another object of the present invention is to provide an external ink supply and balancing system for inkjet printer, in which each ink container in the holder of the inkjet printer has a hole at one side and a connector fastened to the hole for the connection of one respective flexible ink supply tube that is connected to one respective external ink bottle. Each external ink bottle has an ink bottle connector provided to the top for the connection of one respective flexible ink supply tube from the corresponding ink container, and a tube suspending on the inside. During an ink supply flow, the exhaust air is exchanged with the ink.

[0014] Another object of the present invention is to provide an external ink supply and balancing system for inkjet printer, in which each external ink bottle is mounted with an ink bottle connector for the connection of one respective flexible ink supply tube from the corresponding ink container and a top air discharge connector that is connected to the external air bag through one respective flexible tube. When the external air bag reaches the saturated status, one top air discharge connector can be detached from the respective ink bottle, and then the air bag can be flattened to empty cumulated air.

[0015] Another object of the present invention is to provide an external ink supply and balancing system for inkjet printer, in which the flexible tubes extend from the top air discharge connectors at the ink bottles are connected to the external air bag by an air bag connector. The air bag connector has a flat rear coupling tube that receives the flexible tubes being extended from the top air discharge connectors, a circular front coupling tube that is fastened to the spout tube of the external air bag, and a passage in communication between the flat rear coupling tube and the circular front coupling tube. When the external air bag reaches the saturated status, the air bag connector can be detached from the air bag, and then the air bag can be flattened to empty cumulated air.

[0016] Another object of the present invention is to provide an external ink supply and balancing system for inkjet printer, in which each ink bottle has a hole for the connection of the respective top air discharge connector in an airtight manner, and the flexible tubes that are connected between the top air discharge connectors at the ink bottles and the external air bag are arranged into a combine tube that has one end mounted with an air bag connector for connection to the spout tube of the external air bag.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** is a perspective view of a conventional inkjet printer.

[0018] FIG. **2** is a schematic drawing showing the Active Air Management of the inkjet printer.

[0019] FIG. **3** is an ink circulation flow chart, showing inks guided into the ink chamber of the printing-fluid delivery system.

[0020] FIG. **4** is an ink circulation flow chart, showing air exhaust out of the ink chamber of the printing-fluid delivery system.

[0021] FIG. **5** is an ink circulation flow chart, showing inks flowed back from the vent chambers.

[0022] FIG. **6** is a perspective view of the present invention, showing an external ink supply and balancing system installed in an inkjet printer.

[0023] FIG. **7** is a plain view of the present invention, showing the external ink supply and balancing system of the ink printer.

[0024] FIG. **8** is a perspective view of the present invention, showing the arrangement of the flexible ink supply tubes of the external ink supply and balancing system.

[0025] FIG. **9** is an exploded view of a part of the present invention, showing the flexible ink supply tube with the respective L-shaped connector disconnected from the ink container.

[0026] FIG. **10** is a perspective view of the present invention, showing the flexible ink supply tube with the respective L-shaped connector connected to the ink container.

[0027] FIG. **11** is a sectional view of the present invention, showing the relationship between the ink container and the holder.

[0028] FIG. **12** is a sectional view of a part of the present invention, showing a hard stopper sealed to the upper plug hole of the ink container.

[0029] FIG. **13** is a sectional view of a part of the present invention, showing a soft stopper sealed to the upper plug hole of the ink container.

[0030] FIG. **14** is a sectional view of a part of the present invention, showing a rubber plug fastened to the upper plug hole of the ink container.

[0031] FIG. **15** is an exploded view of the present invention, showing one ink bottle of the external ink supply and balancing system.

[0032] FIG. **16** is an assembly view of the present invention, showing one ink bottle of the external ink supply and balancing system.

[0033] FIG. **17** is a sectional side view of the present invention, showing one ink bottle of the external ink supply and balancing system.

[0034] FIG. **18** is an enlarged view of the upper part of FIG. **17**.

[0035] FIG. **19** is a perspective view of the present invention, showing a part of the external ink supply and balancing system.

[0036] FIG. **20** is an exploded view of a part of the present invention, showing the connector of the flexible tubes of the ink balancing unit of the external ink supply and balancing system disconnected from the spout tube of the air bag.

[0037] FIG. **21** is a sectional view in an enlarged of a part of the present invention, showing the connector of the flexible tubes of the ink balancing unit of the external ink supply and balancing system disconnected from the spout tube of the air bag.

[0038] FIG. **22** is a perspective view of the present invention, showing an alternate form of ink bottles used in the external ink supply and balancing system.

[0039] FIG. **23** is a sectional view in an enlarged of a part of the present invention, showing an alternate form of ink bottles used in the external ink supply and balancing system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0040] Referring to FIGS. **1** to **5**, an ink supply system is shown installed in a conventional inkjet printer **11**. The inkjet printer **11** has a holder **13** at the front side. The holder **13** has a number of an ink-container bays **20** adapted for receiving a respective ink container **12**, and two plug pipes **27** and **28** suspending in each ink-container bay **20** at different elevations. After insertion of one ink container **12** into one ink-container bay **20**, the plug pipes **27** and **28** have the respective front ends inserted into the ink container **12** and kept in air communication with the inside of the ink container **12**. The upper plug pipe **27** in each ink-container bay **20** has its rear end connected with a respective flexible tube **39**. The flexible tubes **39** are arranged in parallel and respectively extended from the respective upper plug pipes **27** in the ink-container bay **20** to a respective vent chamber **14**. The lower plug pipe **28** is each ink-container bay **20** has its rear end connected with a respective flexible tube **69**. The flexible tubes **69** are arranged in parallel and respectively extended from the respective lower plug pipes **28** in the ink-container bays **20** to a respective ink chamber **19** in the printing-fluid delivery system **16**. A reversible pump **15** is set between the ink chamber **19** and the plug pipes **28** in the ink-container bays **20**, and controllable to pump ink from the ink containers **12** to the ink chambers **19** in the printing-fluid delivery system **16** or to pump air out of the ink chambers **19** into the ink containers **12** and then the vent chambers **14**.

[0041] Please referring to FIGS. **1** to **3**, when the inkjet printer **11** is started at its first use, the system initializes a first in circulation. During this first ink circulation, the reversible pump **15** is controlled to pump inks **29** from the ink containers **12** to the ink chamber **19** of the printing-fluid delivery system **16** and to pump air out of the ink chambers **19** and accumulation chambers **18** of the printing-fluid delivery system **16** into the ink containers **12** and then the vent chambers **14**. The ink circulation is repeated again and again until the ink chambers **19** and accumulation chambers **18** of the printing-fluid delivery system **16** have been fully filled up with the respective inks. During the first ink circulation process, two circulation flows are employed. These two circular flows will be explained further.

[0042] Referring to FIGS. **2** and **4**, when the inks in the ink chambers **19** of the printing-fluid delivery system **16** are reducing following the printing service of the inkjet printer **11**, a corresponding amount of air enters the ink chambers **19** to substitute for the amount of inks consumed and to balance the pressure in the ink chambers **19**. When the ink in one ink chamber **19** dropped below a predetermined low level, a demand signal is produced, causing the reversible pump **15** to start the ink supply flow, so that the reversible pump **15** pumps the ink **29** from the respective ink container **12** to the respective ink chamber **19** in the printing-fluid delivery system **16** and pumps air out of the respective ink chamber **19** into the respective ink container **12**. After two or three circulations have been done, the respective ink chamber **19** is fully filled up with the respective ink **19** for printing. During every circulation flow, the ink **29** is guided from the respective ink container **12** toward the printing-fluid delivery system **16**, and then air is exhausted out of the ink chamber **19**. When the reversible pump **15** pumps air out of the ink chamber **19** through one ink container **12** to the corresponding vent chamber **14**, air bubbles are produced in the ink **29** in the respective ink container **12**. Following release of air pressure, the air bubbles in the ink **29** move to the corresponding pressure-buffering vent chamber **14**.

[0043] Please referring to FIGS. **2** and **5**, during every circulation flow, a certain amount of the ink **29** is carried by the pressurized air into the corresponding vent chamber **14** in the form of ink bubbles. After the end of the circulation flow, ink bubbles contract gradually and finally pop and convert into water-like ink, and residual ink will be guided back to the respective ink container **12** in a next circular flow for use.

[0044] Please referring to FIGS. **2** and **6** to **8**, when an ink supply and balancing unit of the present invention is used in the aforesaid inkjet printer **11**, the passages between the respective ink containers **12** in the holder **13** and the respective vent chambers **14** are blocked, and then each ink container **12** is drilled to provide a round hole for the mounting of a respective L-shaped connector **61**. Flexible ink supply tubes **48** having different lengths are arranged into a combine tube and respectively extended from the L-shaped connectors **61** at the ink containers **12** along the plane of the holder **13** out of the inkjet printer **11** to respective plug pipes **44** at respective ink bottle connectors **40** of ink bottles **31**. The ink bottles **31** are arranged in parallel and abutted one against another at one lateral side of the inkjet printer **11**, so that inks **32** can be guided out of the ink bottles **31** to the ink chamber **19** of the printing-fluid delivery system **16**, and exhaust air can be guided out of the ink bottles **31** through respective top air discharge connectors **50** to an air bag **58**.

[0045] Please referring to FIGS. **2**, and **8** to **10**, every ink container **12** in the holder **13** of the inkjet printer **11** has a round hole **62** for the mounting of one end of the respective L-shaped connector **61**, which has its other end connected to the respective flexible ink supply tube **48**. After insertion of ink containers **12** into the holder **13**, the flexible ink supply tubes **48** are respectively extended from the L-shaped connectors **61** and then arranged in the form of a combine tube **49** at a suitable location and closely attached to the surface of the holder **13**, allowing the other ends of the flexible ink supply tubes **48** to be respectively connected to the ink bottles **31** at one lateral side of the inkjet printer **11**.

[0046] When one ink container **12** is inserted into one respective ink-container bay **20** in the holder **13** of the inkjet printer **11**, as shown in FIGS. **2** and **11**, two plug holes **63** and **64** of the inserted ink container **12** are respectively forced into engagement with the plug pipes **27** and **28** in the respective ink-container bay **20**. The plug holes **63** and **64** of the inserted ink container **12** have a respective sealing member **25** mounted therein. When the plug pipes **27** and **28** are respectively inserted into the plug holes **63** and **64** of the inserted ink container **12**, the sealing members **25** seal the gap, preventing ink leakage.

[0047] When the ink containers **12** in the inkjet printer **11** are connected to an external ink supply system, the passages between the upper plug pipes **27** in the ink-container bays **20** of the holder **13** and the respective upper plug holes **63** of the ink containers **12** must be blocked, preventing interference with the ink supply operation of the external ink supply system.

[0048] Please referring to FIGS. **2**, **8** and **12**, the interference prevention is done by: first, blocking the upper plug hole **63** of each ink container **12** to isolate the ink into the vent

chamber **14**; second, a round hole **62** is made in one side of each ink container **12** for the mounting of one end of the respective L-shaped connector **61**, which has its other end connected to the respective flexible ink supply tube **48**. By means of this arrangement, exhaust air is prohibited from entering the corresponding vent chamber **14** but guided out of the ink container **12** through the associating L-shaped connector **61** and the associating flexible ink supply tube **48**.

[0049] Please referring to FIG. **12**, a stopper **65** is fastened to the upper plug hole **63** of the ink container **12** to seal the passage between the ink container **12** and the corresponding upper plug pipe **27**. The stopper **65** can be made of any material in any shape. For example, a silicon rubber material is filled in the upper plug hole **63** and hardened to form the stopper **65** that seals the plug hole **63**. Alternatively, the stopper **65**A can be a hard cylindrical stopper press-fitted into the plug hole **63** (shown FIG. **12**), a soft rubber stopper **65**B fitted into the plug hole **63** (shown FIG. **13**), or a rubber plug stopper **65**C used to substitute for the original sealing member **25** (shown FIG. **14**). In either of the aforesaid various different alternate forms, the stopper **65** seals the passage of the plug hole **63**.

[0050] Please referring to FIGS. **8** to **10**, each ink container **12** in the holder **13** of the inkjet printer **11** has one round hole **62** and a L-shaped connector **61** fastened to the round hole **62** and connected with one respective flexible ink supply tube **48** so that each ink circulation path of the inkjet printer **11** is extending to the outside of the inkjet printer **11** through the L-shaped connector **61** at the associating ink container **12** and the associating flexible ink supply tube **48**.

[0051] Please referring to FIGS. **6** and **7**, the combine tube **49** extends out of the top side of the holder **13** of the inkjet printer **11**, and is comprised of multiple flexible ink supply tubes **48** that have different lengths and respectively connected between the ink containers **12** in the holder **13** and the plug pipes **44** of the ink bottle connectors **40** that are respectively fastened to the ink bottles **31** at one lateral side of the inkjet printer **11**.

[0052] Please referring to FIGS. **15** to **17**, each ink bottle **31** has a substantially rectangular container; a bottle plug **35** fastened to the bottle neck **34** thereof, and a tube **38** suspending from the bottle plug **35**. The bottle plug **35** has a first cylindrical hole **36** and a second cylindrical hole **37** axially cut through the top and bottom sides. The tube **38** is connected to the second cylindrical hole **37** and extending downwards from the bottle plug **35** in the ink bottle **31** to an elevation in proximity to the bottom wall of the ink bottle **31**. The first cylindrical hole **36** has a diameter greater than the second cylindrical hole **37**, and is disposed in air communication with the inside space of the ink bottle **31**. Further, each ink bottle **31** is filled with an ink **32**. The bottle plug **35** of the ink bottle **31** is mounted with one respective ink bottle connector **40**, which has a plug pipe **44** disposed in communication with the tube **38** in the ink bottle **31** through a L-shaped passage **45** so that the ink **32** can be guided out of the respective ink bottle **31** through the L-shaped passage **45** to the corresponding ink container **12**.

[0053] The ink bottle connector **40** that is fastened to the top side of the bottle plug **35** in one ink bottle **31** further comprises a body portion **41** of a predetermine diameter, and a first plug pipe **42** and a second plug pipe **43** at the bottom side of the body portion **41**. When fastening the ink bottle connector **40** to the top side of the bottle plug **35**, the first plug pipe **42** is plugged into the first cylindrical hole **36**, and the second plug pipe **43** is plugged into the second cylindrical hole **37**. The plug pipe **44** of the ink bottle connector **40** is suspending in the periphery of the body portion **41** for the connection of the associating flexible ink supply tube **48** that has its other end connected to the corresponding ink container **12**, and disposed in communication with the second plug pipe **43** through the L-shaped passage **45**.

[0054] The body portion **41** has a predetermined thickness. The first plug pipe **42** fits the first cylindrical hole **36** in diameter. When the first plug pipe **42** is press-fitted into the first cylindrical hole **36**, it is secured to the bottle plug **35** in a water tight manner. The ink bottle connector **40** further comprises a top receptacle **46** perpendicularly upwardly extending from the top wall of the body portion **41** in axial alignment with the first plug pipe **42**, and an inside hole **74** in communication between the axial hole **47** defined in the top receptacle **46** and the first plug pipe **42**. Therefore, the axial hole **47** is disposed in air communication with the space **33** inside the ink bottle **31** above the level of the ink **32**.

[0055] For allowing exhaust of air and prohibiting exhaust air from passing to the atmosphere during each ink circulation process of the inkjet printer, as shown in FIGS. **6** and **7**, the ink bottle connector **40** at each ink bottle **31** is provided with one respective top air discharge connector **50**. The top air discharge connector **50** is connected with a flexible tube **55**. The flexible tubes **55** that are respectively extended from the top air discharge connectors **50** at the ink bottles **31** are arranged together and connected to the aforesaid air bag **58** through a connector **57**. Therefore, during each ink circulation operation of the inkjet printer, exhaust air is gathered in the air bag **58**. Because the ink **32** in each ink bottle **31** is constantly kept in an airtight environment, the chemical composition of the ink **32** will not deteriorate, i.e., the ink quality is maintained.

[0056] Referring to FIGS. **15** to **18**, the top air discharge connector **50** comprises a stop plate **67**, a plug pipe **51** disposed at one side of the stop plate **67** for the connection of the respective flexible tube **55**, a grip plate **54** at the top side of the stop plate **67** by which a person can mount/dismount the top air discharge connector **50** conveniently, a plug pipe **52** downwardly extending from the stop plate **67** in fluid communication with the plug pipe **51** through a L-shaped passage **53**, which is defined in the stop plate **67**. The plug pipe **52** is press-fitted into the axial hole **47** of the top receptacle **46** of the corresponding ink bottle connector **40**. When installed, as shown in FIG. **6**, the flexible tubes **55** that are respectively extended from the top air discharge connectors **50** at the ink bottles **31** are arranged together and connected to the connector **57** at the air bag **58**.

[0057] Referring to FIGS. **6**, **7**, and **19** to **21**, the flexible tubes **55** that are respectively connected between the top air discharge connectors **50** at the ink bottles **31** and the connector **57** at the air bag **58** are arranged into a combine tube **56**. The connector **57** has a flat rear coupling tube **68** that receives the combine tube **56**, a circular front coupling tube **69** that is fastened to a spout tube **59** of the air bag **58**, and a passage **60** in communication between the flat rear coupling tube **68** and the circular front coupling tube **69**.

[0058] After connection of the circular front coupling tube **69** to the spout tube **59** of the air bag **58**, an adhesive is applied to the connection area between the circular front coupling tube **69** to the spout tube **59** to fixedly secure the circular front coupling tube **69** and the spout tube **59** together. After installation, the combine tube **56** is connected to the flat rear coupling tube **68**, and the circular front coupling tube **69** is

connected to the spout tube **59** of the air bag **58**, and therefore the combine tube **56** is in air communication with the inside space of the air bag **58** through the passage **60**. The connector **57** further comprises an inside retaining ring **70** in the passage **60** and an inside annular flange **71** around the inside wall of the circular front coupling tube **69**. When the circular front coupling tube **69** is fastened to the spout tube **59**, the inside retaining ring **70** and the inside annular flange **71** give a pressure to the spout tube **59**, enhancing the connection tightness between the circular front coupling tube **69** and the spout tube **59**.

[0059] The air bag **58** is an inflatable bag closely attached to one lateral side of the inkjet printer **11**. During each ink circulation operation of the inkjet printer **11**, exhaust air go into the ink bottles **31** and then go through the respective top air discharge connectors **50** toward the air bag **58**, and therefore exhaust air is collected in the air bag **58**.

[0060] After a certain number of ink circulation cycles with the use of the inkjet printer **11**, the amount of exhaust air collected in the air bag **58** is increased. When accumulated air in the air bag **58** reaches a saturation status, the connector **57** is disconnected from the spout tube **59** of the air bag **58**, and then the air bag **58** is flattened to force accumulated air out of the air bag **58**. After the air bag **58** is cleared, the spout tube **59** of the air bag **58** is connected to the connector **57** again for collecting exhaust air from the inkjet printer **11**.

[0061] In general, an external ink supply device is connected to the inkjet printer **11**. The external ink supply device comprises a plurality of ink bottles **31**. Each ink bottle **31** is mounted with a respective ink bottle connector **40**. The ink bottle connectors **40** are respectively connected with a respective flexible ink supply tube **48**. The flexible ink supply tubes **48** are respectively connected to the ink containers **12** in the holder **13** of the inkjet printer **11**, and arranged together in the form of a combine tube **49**. Each ink container **12** has the respective upper plug hole **63** sealed with a stopper **65** to block the original exhaust system, and is mounted with a respective L-shaped connector **61**, which is connected to the corresponding ink bottle **31** to provide a passage for exhaust air. Therefore, the ink bottles **31** can provide respective inks to the corresponding ink containers **12** and allow exhaust air to be guided out of the inkjet printer **11**.

[0062] The ink bottle connectors **40** at the ink bottles **31** are respectively connected to the ink containers **12** in the inkjet printer **11** and respectively mounted with a respective top air discharge connector **50** that is respectively connected to an air bag **58**. Therefore, when air is exhausted out of the ink containers **12**, it is not discharged into the atmosphere but guided through the top air discharge connectors **50** to the air bag **58**.

[0063] Normally, the ink **32** in each ink bottle **31** is kept in an airtight environment, and every ink circulation operation of the inkjet printer **11** is performed in an enclosed space, preventing deterioration of the chemical composition of the ink **32** and maintaining the printing quality.

[0064] Referring to FIGS. **22** and **23**, the ink bottle **31**A has a bottle body **72** that has the same configurations as the ink bottle commonly used in conventional external ink supply devices. The bottle body **72** has a top plug hole **73** for the connection of one top air discharge connector **50** that is connected to an air bag **58** through one respective flexible tube **55**. The flexible tubes **55** that are connected between the top air discharge connectors **50** at the ink bottles **31**A and the air bag **58** are arranged into a combine tube **56**. When the inkjet **11** is started to run an ink circulation flow, exhaust air is collected in the air bag **58**.

[0065] While the invention has been described with reference to specific embodiments it must be understood that those embodiments are susceptible to many changes, substitutions and modifications that will be readily apparent to those having ordinary skill in the art without departing from the scope and spirit of the invention.

What is claimed is:

1. An external ink supply and balancing system for inkjet printer, the external ink supply and balancing system comprising:

an ink supply unit, comprising:

a plurality of ink containers respectively mounted in said inkjet printer, each said ink container comprising an upper plug hole sealed with a stopper, a round hole at one side thereof;

a plurality of L-shaped connectors respectively fastened to the round holes of said ink containers;

a plurality of ink bottles, each said ink bottle holding therein an ink and having an inside space above the level of the ink therein; and

a plurality of flexible ink supply tubes respectively connected between said L-shaped connectors and said ink bottles for enabling the inks in said ink bottle to be respectively supplied to said ink containers; and

an ink balancing unit, comprising:

a plurality of air discharge connectors respectively connected to said ink bottles for guiding air out of said ink bottles, each said air discharge connector comprising a plug pipe connected to one said ink bottle and a plug pipe disposed in air communication with said plug pipe;

an air bag for collecting exhaust air from said ink bottles, said air bag comprising a spout tube for input of exhaust air;

an air bag connector, said air bag connector comprising a flat rear coupling tube, a circular front coupling tube fastened to the spout tube of said air bag and disposed in communication with said flat rear coupling tube; and

a plurality of flexible tubes respectively connected between the plug pipes of said air discharge connectors and said flat rear coupling tube of said air bag connector for guiding exhaust air from said ink bottles to said air bag.

2. An external ink supply and balancing system for inkjet printer as claimed in claim **1**, wherein said ink bottle comprises a bottle body having a bottle neck, a bottle plug fastened to said bottle neck, said bottle plug having a cylindrical hole for the connection of one said air discharge connector, and a tube fastened to said bottle plug and suspending in said bottle body and disposed in fluid communication with one said flexible ink supply tube.

3. An external ink supply and balancing system for inkjet printer as claimed in claim **1**, wherein said ink bottle comprises a bottom plug pipe disposed at a bottom side thereof and connected to one said L-shaped connector at one said ink container through one said flexible ink supply tube, and a top plug hole connected to one said air discharge connector.

4. An external ink supply and balancing system for inkjet printer, the external ink supply and balancing system comprising:

an ink supply unit, comprising a plurality of ink bottles disposed outside said inkjet printer and respectively connected to respective ink containers in said inkjet printer by a respective flexible ink supply tube; and

an ink balancing unit, comprising:

a plurality of air discharge connectors respectively connected to said ink bottles for guiding air Out of said ink bottles, each said air discharge connector comprising a plug pipe connected to one said ink bottle and a plug pipe disposed in air communication with said plug pipe;

an air bag for collecting exhaust air from said ink bottles, said air bag comprising a spout tube for input of exhaust air;

an air bag connector, said air bag connector comprising a flat rear coupling tube, a circular front coupling tube fastened to the spout tube of said air bag and disposed in communication with said flat rear coupling tube; and

a plurality of flexible tubes respectively connected between the plug pipes of said air discharge connectors and said flat rear coupling tube of said air bag connector for guiding exhaust air from said ink bottles to said air bag.

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