INKJET PRINTHEAD WITH APERTURED SEALING FILM

FIELD OF THE INVENTION

The present invention relates to printers and in particular inkjet printers. Specific aspects of the invention relate to cartridges for printers, printhead design and maintenance, as well as other facets of printer operation.

CO-PENDING APPLICATIONS

The following applications have been filed by the Applicant simultaneously with the present application:

SHA VPA MFA WPA PNA

RRB

The disclosures of these co-pending applications are incorporated herein by reference. The above applications have been identified by their filing docket number, which will be substituted with the corresponding application number, once assigned.

CROSS REFERENCES TO RELATED APPLICATIONS

The following patents or patent applications filed by the applicant or assignee of the present invention are hereby incorporated by cross-reference.

6,795,215	10/884,881	PEC01NP	09/575,109	10/296,535	09/575,110	6,805,419
09/607,985	6,398,332	6,394,573	6,622,923	6,747,760	10/189,459	PEC14US
PEC15US	10/727,181	10/ 727,162	10/727,163	10/727,245	10/727,204	10/727,233
10/727,280	10/727,157	10/727,178	10/727,210	10/727,257	10/727,238	10/727,251
10/727,159	10/727,180	10/727,179	10/727,192	10/727,274	10/727,164	10/727,161
10/727,198	10/727,158	10/754,536	10/754,938	10/727,227	10/727,160	PEA29US
10/854,521	10/854,522	10/854,488	10/854,487	10/854,503	10/854,504	10/854,509
10/854,510	10/854,496	10/854,497	10/854,495	10/854,498	10/854,511	10/854,512
10/854,525	10/854,526	10/854,516	10/854,508	10/854,507	10/854,515	10/854,506
10/854,505	10/854,493	10/854,494	10/854,489	10/854,490	10/854,492	10/854,491
10/854,528	10/854,523	10/854,527	10/854,524	10/854,520	10/854,514	10/854,519
PLT036US	10/854,499	10/854,501	PLT039US	10/854,502	10/854,518	10/854,517
PLT043US	10/728,804	10/728,952	10/728,806	10/728,834	10/729,790	10/728,884
10/728,970	10/728,784	10/728,783	10/728,925	10/728,842	10/728,803	10/728,780
10/728,779	10/773,189	10/773,204	10/773,198	10/773,199	10/773,190	10/773,201

10/773,191	10/773,183	10/773,195	10/773,196	10/773,186	10/773,200	10/773,185
10/773,192	10/773,197	10/773,203	10/773,187	10/773,202	10/773,188	10/773,194
10/773,193	10/773,184	10/760,272	10/760,273	10/760,187	10/760,182	10/760,188
10/760,218	10/760,217	10/760,216	10/760,233	10/760,246	10/760,212	10/760,243
10/760,201	10/760,185	10/760,253	10/760,255	10/760,209	10/760,208	10/760,194
10/760,238	10/760,234	10/760,235	10/760,183	10/760,189	10/760,262	10/760,232
10/760,231	10/760,200	10/760,190	10/760,191	10/760,227	10/760,207	10/760,181
6,746,105	6,623,101	6,406,129	6,505,916	6,457,809	6,550,895	6,457,812
6,428,133	IJ52NP	10/407212	10/407207	10/683064	10/683041	10/882774
10/884889	10/922890	JUM008US	JUM009US	JUM010US	10/922884	JUM012US
JUM013US	JUM014US	JUM015US	JUM016US	10/922871	10/922880	JUM019US
10/922882	JUM021US	10/922878	JUM023US	10/922876	JUM025US	10/922877
10/815625	10/815624	10/815628	10/913375	10/913373	10/913374	IRB004US
10/913377	10/913378	10/913380	10/913379	10/913376	10/913381	IRB011US
09/575187	6727996	6591884	6439706	6760119	09/575198	09/722148
09/722146	09/721861	6290349	6428155	6785016	09/608920	09/721892
09/722171	09/721858	09/722142	10/171987	10/202021	10/291724	10/291512
10/291554	10/659027	10/659026	10/831242	10/884885	10/884883	10/901154
NPP049US	NPP051US	NPP052US	NPP053US	NPP054US	NPP057US	NPP058US
NPP062US	10/659027	09/693301	09/575197	09/575195	09/575159	09/575132
09/575123	09/575148	09/575130	09/575165	6813039	09/575118	09/575131
09/575116	6816274	09/575139	09/575186	6681045	6728000	09/575145
09/575192	09/575181	09/575193	09/575183	6789194	09/575150	6789191
6549935	09/575174	09/575163	6737591	09/575154	09/575129	09/575124
09/575188	09/575189	09/575170	09/575171	09/575161	6644642	6502614
6622999	6669385	CAA001US	CAA002US	CAA003US	CAA004US	CAA005US
CAA006US	CAA007US	CAA008US	CAA009US	CAA010US	CAA011US	CAA012US
CAA013US	CAA014US	CAA015US	CAA016US	CAA017US	CAB001US	CAC001US
CAD001US	CAE001US	CAF001US	CAF002US	CAF003US	CAF004US	

Some applications have been listed by docket numbers. These will be replaced when application numbers are known.

BACKGROUND OF THE INVENTION

Traditionally, most commercially available inkjet printers have a print engine which forms part of the overall structure and design of the printer. In this regard, the body of the printer unit is typically constructed to accommodate the printhead and associated media delivery mechanisms, and these features are integral with the printer unit.

This is especially the case with inkjet printers that employ a printhead that traverses back and forth across the media as the media is progressed through the printer unit in small iterations. In such cases the reciprocating printhead is typically mounted to the body of the printer unit such that it can traverse the width of the printer unit between a media input roller and a media output roller, with the media input and output rollers forming part of the structure of the printer unit. With such a printer unit it may be possible to remove the printhead for replacement, however the other parts of the print engine, such as the media transport rollers, control circuitry and maintenance stations, are typically fixed within the printer unit and replacement of these parts is not possible without replacement of the entire printer unit.

As well as being rather fixed in their design construction, printer units employing reciprocating type printheads are considerably slow, particularly when performing print jobs of full colour and/or photo quality. This is due to the fact that the printhead must continually traverse the stationary media to deposit the ink on the surface of the media and it may take a number of swathes of the printhead to deposit one line of the image.

Recently, it has been possible to provide a printhead that extends the entire width of the print media so that the printhead can remain stationary as the media is transported past the printhead. Such systems greatly increase the speed at which printing can occur as the printhead no longer needs to perform a number of swathes to deposit a line of an image, but rather the printhead can deposit the ink on the media as it moves past at high speeds. Such printheads have made it possible to perform full colour 1600dpi printing at speeds in the vicinity of 60 pages per minute, speeds previously unattainable with conventional inkjet printers.

Such a pagewidth printhead typically requires high precision and high speed paper movement, and as such, the entire print engine (printhead, paper handling mechanisms and control circuitry etc) must be configured accordingly to ensure high quality output.

Accordingly, there is a need to provide a print engine having a pagewidth printhead that can be readily employed within a standard body of a printer unit and is constructed in a manner that ensures that all the necessary parts of the print engine are configured in a manner that enables consistent, high speed printing.

SUMMARY OF THE INVENTION

In a first aspect the present invention provides a cartridge unit for an inkjet printer, the cartridge unit comprising:
an ink storage compartment and an ink feed system for connection to a printhead assembly with an array of ink ejection nozzles; wherein,
the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein.

Without negative pressure, an ink meniscus can bulge from the nozzles. The meniscus will 'pin' itself to the edge of the nozzle aperture and may be strong enough to stop ink leakage. However, paper dust or other contaminants will eventually stop the bulging meniscus from pinning itself on the nozzle rim and leakage occurs. A negative pressure in the ink storage volume makes the meniscus invert back into the nozzle aperture. As the meniscus does not bulge out of the nozzle, paper dust on the nozzle surface does not break the surface tension to cause leakage.
In some embodiments, the ink storage compartment has opposed wall sections connected by a flexible wall arrangement to define the variable ink storage volume; such that one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume. The opposed wall section may be biased with a constant force spring.
Optionally, the printhead assembly is fixed to the cartridge unit for removal and replacement therewith. In another option, the printhead assembly is a pagewidth printhead assembly.

Optionally the ink storage compartment has opposed wall sections connected by a flexible wall arrangement to define the variable ink storage volume; such that one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume.

Optionally the opposed wall section is biased with a constant force spring.

Optionally the printhead assembly is fixed to the cartridge unit for removal and replacement therewith.

Optionally the printhead assembly is a pagewidth printhead assembly.

In a further aspect there is provided a cartridge unit, wherein:
the negatively pressurized ink storage compartment has an interface for receiving a refill unit for refilling the ink storage compartment, the interface having an inlet valve biased to its closed configuration; and
the refill unit comprises:
a body containing a quantity of ink;
engagement formations for releasably engaging the interface; and
an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a cartridge unit, wherein:
the negatively pressurized ink storage compartment has an interface for receiving an ink refill unit for refilling the ink storage compartment, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment; and
the refill unit comprises:
a body containing a quantity of ink; and
a docking portion having an ink outlet and valve actuator formations, the docking portion, during use, releasably engaging the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a cartridge unit, wherein:
the negatively pressurized ink storage compartment is arranged to be refilled by a refill unit via a normally open outlet valve; and
the refill unit comprises:
a body containing a quantity of ink;
engagement formations for releasably engaging the ink storage compartment; and
an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a cartridge unit, wherein:
the ink storage compartment is arranged to be refilled by a refill unit; and
the refill unit comprises:
a body containing a quantity of ink;
an ink outlet; and

a repressurizing arrangement which, upon engagement of the refill unit with the ink storage compartment, causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and which, upon subsequent disengagement of the refill unit from the ink storage compartment, releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a cartridge unit, wherein:
the ink storage compartment has opposed wall sections connected by a flexible wall arrangement to define the variable storage volume;
the cartridge unit further comprises an ink feed system for supplying for supplying ink to a printhead with an array of nozzles; and
one of the opposed wall sections is displaceable and biased to expand the variable storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a cartridge unit, wherein:
the ink storage compartment has an interface for releasably engaging with a refill unit for refilling the ink storage compartment, the interface having valves for controlling ink flows into, and out of, the storage compartment; and
the refill unit comprises:
a body containing a quantity of ink;
an ink outlet; and,
valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a cartridge unit, further comprising an interface for releasably engaging a refill unit for refilling the cartridge unit,
wherein the inkjet printer incorporates a printhead, control circuitry and the refill unit, the refill unit comprising:
a body containing a quantity of ink;
an ink outlet; and

a memory circuit for storing information relating to at least one characteristic of the ink, which during use, allows the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a cartridge unit incorporating a printhead maintenance assembly for an inkjet printhead of the inkjet printer, the printhead having a nozzle plate with an array of nozzles formed therein,
wherein the printhead maintenance assembly comprises:

a capper to cover the array of nozzles when the printhead is not in use; and

a cleaner for engaging the nozzle plate and wiping across the nozzles, the cleaner being positioned between opposing sides of the capper.

In a further aspect there is provided a cartridge unit, wherein the inkjet printer comprises:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a cartridge unit, further comprising an interface for engaging an ink refill unit for replenishing the cartridge, the ink refill unit comprising:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

In a further aspect there is provided a cartridge unit, further comprising an interface for engaging an ink refill unit for replenishing the cartridge,
wherein the ink storage compartment is partially defined by a tubular flexible wall;

the cartridge unit further comprising a constriction mechanism for constricting the flexible tubular wall by a predetermined amount; and

the ink refill unit comprises:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a cartridge unit, further comprising a refill unit and an interface for engaging an ink refill unit for replenishing the cartridge, the ink refill unit comprising:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface,

wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a cartridge unit engageable with an ink refill unit for replenishing the cartridge, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a cartridge unit,

wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior;

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

wherein the lid and the panel both open in the same direction.

In a further aspect there is provided a cartridge unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a cartridge unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions, wherein, in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that, the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a cartridge unit, further comprising:

an ink feed system for supplying ink from the or each ink compartment to a printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a cartridge unit arranged to be held by a cradle within the inkjet printer, the cradle comprising a plurality of interfaces respectively corresponding to the storage compartments, each of the interfaces being configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a cartridge unit, wherein the printer incorporates a printhead comprising:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a cartridge unit, wherein the printer incorporates a printhead comprising:

a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;

a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and

a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits, polymer sealing film being more than 25 microns thick.

In another aspect the present invention provides a cartridge unit for an inkjet printer, the cartridge unit comprising:

an ink storage compartment and an ink feed system for connection to a printhead assembly with an array of ink ejection nozzles; wherein,

the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein; such that,

ink does not inadvertently leak from the ink ejection nozzles.

In a second aspect the present invention provides a refill unit for refilling a ink storage compartment that supplies ink to a printhead assembly, the ink storage compartment having an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration, the refill unit comprising:

a body containing a quantity of ink; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

By configuring the refill unit so that it opens the inlet valve on the ink cartridge at the same time that it docks with the cartridge, the risk of dust or other contaminants getting into the cartridge is reduced. This improves the performance and operational life of the printhead nozzles.

In one preferred embodiment, the interface has an outlet valve and the refill unit further comprises an outlet valve actuator for closing the outlet valve as the refill unit engages the ink interface. Optionally, the inlet valve actuator and the outlet valve actuator are configured so that the outlet valve is closed before the inlet valve is opened as the refill unit engages the ink interface. Optionally, the inlet valve actuator and the outlet valve actuator are both spigot-like projections with a tri-star cross section for robust bending resistance in all lateral directions. Optionally, the ink storage compartment is negatively pressurized so that the quantity of ink is drawn from the body when the refill unit engages the ink interface.

Optionally the interface has an outlet valve and the refill unit further comprises an outlet valve actuator for closing the outlet valve as the refill unit engages the ink interface.

Optionally the inlet valve actuator and the outlet valve actuator are configured so that the outlet valve is closed before the inlet valve is opened as the refill unit engages the ink interface.

Optionally the inlet valve actuator and the outlet valve actuator are both spigot-like projections with a tri-star cross section for robust bending resistance in all lateral directions.

Optionally the ink storage compartment is negatively pressurized so that the quantity of ink is drawn from the body when the refill unit engages the ink interface.

In a further aspect there is provided a refill unit incorporated in a cartridge unit for an inkjet printer, the cartridge unit comprising:

the ink storage compartment and an ink feed system for connection to the printhead assembly with an array of ink ejection nozzles,

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a refill unit, wherein:

the interface has a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment; and

the refill unit further comprises a docking portion having an ink outlet and valve actuator formations, which, during use, releasably engages the interface to actuate the inlet and the outlet valves so the

cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a refill unit, wherein:
the refill unit interfaces with the ink storage compartment via a normally open outlet valve; and
the refill unit further comprises an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a refill unit, wherein:
the printhead assembly has an array of nozzles, and during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;
the refill unit further comprises:
an ink outlet; and
a repressurizing arrangement;
upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a refill unit incorporated in a cartridge for an inkjet printer, the cartridge comprising:
the ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to a printhead with an array of nozzles,
wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a refill unit, wherein:
the interface has valves for controlling ink flows into, and out of, the storage compartment; and

the refill unit further comprises an ink outlet and valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a refill unit for refilling an ink cartridge that forms part of an inkjet printer, the printer also having a printhead, control circuitry and an interface for releasably engaging the refill unit,
wherein the refill unit further comprises an ink outlet and a memory circuit for storing information relating to at least one characteristic of the ink, and
wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a refill unit incorporated in a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill unit,
wherein the ink refill unit comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and
engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, and

wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, wherein:
the ink storage compartment is partially defined by a tubular flexible wall and has a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, and
the ink refill unit further comprises a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill unit,
wherein the ink refill unit further comprises:
an ink outlet for engaging a complementary ink inlet in the interface; and
a spigot extending from the body for insertion in an aperture in the interface, and
wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, wherein the ink refill unit further comprises:
an ink outlet for engaging a complementary ink inlet in the cartridge; and
a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:
an outer casing with a hingedly mounted panel for access its interior; and
a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,
wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and
the lid and the panel both open in the same direction.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a refill unit incorporated in a cartridge for an inkjet printer, the cartridge comprising:

at least one ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to a printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a refill unit incorporated in a cradle for holding an ink cartridge within an inkjet printer, the cartridge having a plurality of the ink storage compartments, the cradle comprising a plurality of the interfaces respectively corresponding to the ink storage compartments, wherein each of the interfaces is configured to receive the ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a refill unit, wherein the printhead assembly comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a refill unit, wherein the printhead assembly comprises:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a third aspect the present invention provides an ink refill unit for an ink cartridge, the ink cartridge having a negatively pressurized ink storage compartment that supplies ink to a printhead assembly, and an interface for receiving the refill unit, the refill unit comprising:

a body containing a quantity of ink; and
a docking portion with an ink outlet; wherein during use,
upon releasable engagement with the interface, the docking portion establishes fluid communication between the body and the ink storage compartment through the ink outlet such that ink is drawn from the body into the cartridge because of the negative pressure in the ink storage compartment.

Automatically establishing a fluid connection upon engagement with the cartridge, makes the use of the refill unit very simple and intuitive. Using the negative pressure in the cartridge to draw the ink out of the refill speeds the refilling process.
In some embodiments, the docking portion has valve actuator formations and the interface has a normally closed inlet valve and a normally open outlet valve, such that the ink outlet forms a sealed connection with the inlet valve upon releasable engagement of the docking portion with the interface. Optionally, the valve actuator formations close the outlet valve and subsequently opens the inlet valve upon releasable engagement of the docking portion with the interface. Optionally, the valve actuator formations are two spigot like projections with a tri star cross section. Optionally, the ink

outlet has a normally closed valve that is configured to open as the ink outlet forms a sealed connection with the inlet valve of the interface.

Optionally the docking portion has valve actuator formations and the interface has a normally closed inlet valve and a normally open outlet valve, such that the ink outlet forms a sealed connection with the inlet valve upon releasable engagement of the docking portion with the interface.

Optionally the valve actuator formations close the outlet valve and subsequently opens the inlet valve upon releasable engagement of the docking portion with the interface.

Optionally the valve actuator formations are two spigot like projections with a tri star cross section.

Optionally the ink outlet has a normally closed valve that is configured to open as the ink outlet forms a sealed connection with the inlet valve of the interface.

In a further aspect there is provided a refill unit incorporated in a cartridge unit for an inkjet printer, the cartridge unit comprising:

the ink storage compartment and an ink feed system for connection to the printhead assembly with an array of ink ejection nozzles,

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a refill unit, wherein:

the interface has an inlet valve biased to its closed configuration; and

the refill unit comprises engagement formations for releasably engaging the interface and an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a refill unit, wherein:

the refill unit interfaces with the ink storage compartment via a normally open outlet valve; and

the refill unit further comprises engagement formations for releasably engaging the ink storage compartment and an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a refill unit, wherein:
the printhead assembly has an array of nozzles, and during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;
the refill unit further comprises:
an ink outlet; and
a repressurizing arrangement;
upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a refill unit incorporated in a cartridge for an inkjet printer, the cartridge comprising:
the ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to a printhead with an array of nozzles,
wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a refill unit, wherein:
the interface has valves for controlling ink flows into, and out of, the storage compartment; and
the refill unit further comprises an ink outlet and valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a refill unit for refilling an ink cartridge that forms part of an inkjet printer, the printer also having a printhead, control circuitry and an interface for releasably engaging the refill unit,
wherein the refill unit further comprises an ink outlet and a memory circuit for storing information relating to at least one characteristic of the ink, and

wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a refill unit incorporated in a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided a refill unit incorporated in an inkjet printer comprising:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a refill unit, wherein:

the docking portion has a base plate with an ink outlet for connection to an inlet port on the interface;

the refill unit further comprises engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate; and

the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided a refill unit, wherein:

the ink storage compartment is partially defined by a tubular flexible wall and has a constriction mechanism for constricting the flexible tubular wall by a predetermined amount; and

the ink refill unit further comprises a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the Constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a refill unit, wherein the ink refill unit further comprises:

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, and

wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a refill unit, further comprising:

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a refill unit incorporated in an inkjet printer comprising:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided a refill unit incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a refill unit incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a refill unit, wherein the cartridge comprises:
at least one ink storage compartment;
an ink feed system for supplying ink from the or each ink compartment to a printhead; and
a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a refill unit incorporated in a cradle for holding an ink cartridge within an inkjet printer, the cartridge having a plurality of the ink storage compartments, the cradle comprising a plurality of the interfaces respectively corresponding to the ink storage compartments, wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a refill unit, wherein the printhead assembly comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a refill unit, wherein the printhead assembly comprises:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a fourth aspect the present invention provides a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to a printhead assembly via a normally open outlet valve, the refill unit comprising:

a body containing a quantity of ink; and

an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

The ink storage compartment is maintained at a negative pressure to avoid ink leakage from the printhead. However, during an ink refill process, the negative pressure is removed when the ink storage volume is filled to capacity. Without the negative pressure in the ink storage compartment, there is a high risk of ink leakage. It is possible to re-establish the negative pressure by slightly increasing the compartments capacity immediately after refilling, but until the negative pressure is re-established, there is a high likelihood of leakage. By designing the refill unit to shut the outlet valve as it engages the storage compartment, ink leakage is prevented until the negative pressure is re-established.

In one preferred embodiment, the ink storage compartment has an inlet valve and the refill unit further comprises an inlet valve actuator for opening valve as the refill unit engages the ink storage compartment. Optionally, the inlet valve actuator and the outlet valve actuator are configured so that the outlet valve is closed before the inlet valve is opened as the refill unit engages the ink storage compartment. Optionally, the inlet valve actuator and the outlet valve actuator are both spigot-like projections with a tri-star cross section for robust bending resistance in all lateral directions. Optionally, the refill unit has a normally closed ink outlet, wherein during use, the ink outlet opens and forms a sealed connection with the inlet valve as the refill unit engages the ink storage compartment.

Optionally the ink storage compartment has an inlet valve and the refill unit further comprises an inlet valve actuator for opening valve as the refill unit engages the ink storage compartment.

Optionally the inlet valve actuator and the outlet valve actuator are configured so that the outlet valve is closed before the inlet valve is opened as the refill unit engages the ink storage compartment.

Optionally the inlet valve actuator and the outlet valve actuator are both spigot-like projections with a tri-star cross section for robust bending resistance in all lateral directions.

Optionally the refill unit has a normally closed ink outlet, wherein during use, the ink outlet opens and forms a sealed connection with the inlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a refill unit incorporated in a cartridge unit for an inkjet printer, the cartridge unit comprising:

the ink storage compartment and an ink feed system for connection to the printhead assembly with an array of ink ejection nozzles,

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a refill unit, wherein:

the ink storage compartment has an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration; and

the refill unit further comprises:

engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided an ink refill unit for an ink cartridge having the negatively pressurized ink storage compartment and an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment,

wherein the refill unit further comprises a docking portion having an ink outlet and valve actuator formations, and

wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a refill unit, further comprising:

an ink outlet; and

a repressurizing arrangement,

wherein upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a refill unit incorporated in a cartridge for an inkjet printer, the cartridge comprising:
the ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to a printhead with an array of nozzles,
wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a refill unit, wherein:
the interface has valves for controlling ink flows into, and out of, the storage compartment; and
the refill unit further comprises an ink outlet and valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a refill unit for refilling an ink cartridge that forms part of an inkjet printer, the printer also having a printhead, control circuitry and an interface for releasably engaging the refill unit,
wherein the refill unit further comprises an ink outlet and a memory circuit for storing information relating to at least one characteristic of the ink, and
wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a refill unit incorporated in a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill unit,
wherein the ink refill unit comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and
engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, and
wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided a refill unit, wherein:
the ink storage compartment is partially defined by a tubular flexible wall and has a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, and
the ink refill unit further comprises a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill unit,
wherein the ink refill unit comprises:

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, and
wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, wherein the ink refill unit further comprises:

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a refill unit incorporated in a cartridge for an inkjet printer, the cartridge comprising:
at least one ink storage compartment;
an ink feed system for supplying ink from the or each ink compartment to a printhead; and
a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a refill unit incorporated in a cradle for holding an ink cartridge within an inkjet printer, the cartridge having a plurality of the ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments, wherein each of the interfaces is configured to receive the ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a refill unit, wherein the printhead assembly comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a refill unit, wherein the printhead assembly comprises:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a fifth aspect the present invention provides a refill unit for refilling an ink storage compartment supplying a printhead assembly with an array of nozzles, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

a repressurizing arrangement; wherein,

upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the ink storage compartment to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and,

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

The ink storage compartment is maintained at a negative pressure to avoid ink leakage from the printhead. However, during an ink refill process, the negative pressure is removed when the ink storage volume is filled to capacity. Without the negative pressure in the ink storage compartment, there is a high risk of ink leakage. By slightly increasing the compartment's capacity as soon as the refill is disengaged, the negative pressure is re-established. Depressing a part of the ink storage compartment during refilling will reduce its volume. However, when the refill unit releases the depressed part, the capacity is correspondingly increased and negative pressure is re-established.
In some embodiments, the ink storage compartment has a flexible wall portion and a constriction mechanism wherein during use the repressurizing arrangement engages the constriction mechanism to make it constrict the flexible wall portion inwards. Optionally, the constriction mechanism has two axially spaced, rectangular collars with four panels extending between them, one of the panels being situated on each side of the rectangular collars respectively, and the pressurizing arrangement is four constrictor actuation projections arranged to engage the four sides of one of the rectangular collars and, in use, push it towards the other collar so that the panels bow inwardly to constrict the flexible wall. Optionally, the ink storage compartment has an inlet valve and an outlet valve, and the refill unit further comprises an inlet valve actuator for opening the inlet valve as the refill unit engages the ink storage compartment, and an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment. Optionally, the inlet valve actuator and the outlet valve actuator are configured so that the outlet valve is closed before the inlet valve is opened as the refill unit engages the ink storage compartment.

Optionally the ink storage compartment has a flexible wall portion and a constriction mechanism wherein during use the repressurizing arrangement engages the constriction mechanism to make it constrict the flexible wall portion inwards.

Optionally the constriction mechanism has two axially spaced, rectangular collars with four panels extending between them, one of the panels being situated on each side of the rectangular collars respectively, and the pressurizing arrangement is four constrictor actuation projections arranged to engage the four sides of one of the rectangular collars and, in use, push it towards the other collar so that the panels bow inwardly to constrict the flexible wall.

Optionally the ink storage compartment has an inlet valve and an outlet valve, and the refill unit further comprises an inlet valve actuator for opening the inlet valve as the refill unit engages the ink storage compartment, and an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

Optionally the inlet valve actuator and the outlet valve actuator are configured so that the outlet valve is closed before the inlet valve is opened as the refill unit engages the ink storage compartment.

In a further aspect there is provided a refill unit incorporated in a cartridge unit for an inkjet printer, the cartridge unit comprising:

the ink storage compartment and an ink feed system for connection to the printhead assembly with an array of ink ejection nozzles,

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a refill unit, wherein:

the ink storage compartment has an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration; and

the refill unit further comprises:

engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a refill unit for an ink cartridge having the negatively pressurized ink storage compartment and an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment,

wherein the refill unit further comprises a docking portion having an ink outlet and valve actuator formations, and

wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a refill unit, wherein:

the refill unit interfaces with the ink storage compartment via a normally open outlet valve; and

the refill unit further comprises engagement formations for releasably engaging the ink storage compartment and an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a refill unit incorporated in a cartridge for an inkjet printer, the cartridge comprising:

the ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and

an ink feed system for supplying for supplying ink to a printhead with an array of nozzles,

wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a refill unit, wherein:

the ink storage compartment has an interface for releasably engaging with the refill unit, the interface having valves for controlling ink flows into, and out of, the storage compartment; and

the refill unit comprises valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a refill unit for refilling an ink cartridge that forms part of an inkjet printer, the printer also having a printhead, control circuitry and an interface for releasably engaging the refill unit,
wherein the refill unit further comprises an ink outlet and a memory circuit for storing information relating to at least one characteristic of the ink, and
wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a refill incorporated in a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the refill unit, wherein the refill unit further comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, and
wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill unit, the ink storage compartment

partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount,
wherein the ink refill unit further comprises a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill unit, wherein the ink refill unit comprises:

the ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, and

wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, wherein the ink refill unit comprises:

the ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a refill unit incorporated in a cartridge for an inkjet printer, the cartridge comprising:

at least one ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to a printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a refill unit incorporated in a cradle for holding an ink cartridge within an inkjet printer, the cartridge having a plurality of the ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments, wherein each of the interfaces is configured to receive the ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a refill unit, wherein the printhead assembly comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a refill unit, wherein the printhead assembly comprises:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a sixth aspect the present invention provides an ink cartridge for an inkjet printer, the cartridge comprising:
an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and,
an ink feed system for supplying for supplying ink to a printhead with an array of nozzles; wherein,
one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

An ink storage compartment with a flexible wall between two rigid walls is particularly suited to providing a variable ink volume that stores ink at a specified negative pressure. One wall can accommodate the necessary inlet and outlet valves while the second can be movable and biased away from the first. By applying biassing force to a plate, it is a simple matter to determine the biassing force necessary to provide a desired negative pressure within the ink storage volume. The basic 'accordion' structure can adopt many shapes and collapse to almost zero volume for efficient ink usage.
In some embodiments, one of the wall sections is fixed within the cartridge and has an inlet valve for connection to an ink refill unit and an outlet valve for connection to the ink feed system. Optionally, the displaceable wall section is biased by a constant force spring. Optionally, the inlet and outlet valves are configured to be opened and closed respectively by the ink refill unit as it engages the ink storage compartment. Optionally, the inlet and outlet valves are configured such that the outlet valve is closed before the inlet valve is opened as the refill unit engages the ink storage compartment.

Optionally one of the wall sections is fixed within the cartridge and has an inlet valve for connection to an ink refill unit and an outlet valve for connection to the ink feed system.

Optionally the displaceable wall section is biased by a constant force spring.

Optionally the inlet and outlet valves are configured to be opened and closed respectively by the ink refill unit as it engages the ink storage compartment.

Optionally the inlet and outlet valves are configured such that the outlet valve is closed before the inlet valve is opened as the refill unit engages the ink storage compartment.

In a further aspect there is provided a cartridge, wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a cartridge, wherein:
the negatively pressurized ink storage compartment has an interface for receiving a refill unit for refilling the ink storage compartment, the interface having an inlet valve biased to its closed configuration; and
the refill unit comprises:
a body containing a quantity of ink;
engagement formations for releasably engaging the interface; and
an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a cartridge, wherein:
the negatively pressurized ink storage compartment has an interface for receiving an ink refill unit for refilling the ink storage compartment, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment; and
the refill unit comprises:
a body containing a quantity of ink; and

a docking portion having an ink outlet and valve actuator formations, the docking portion, during use, releasably engaging the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a cartridge, wherein:
the negatively pressurized ink storage compartment is arranged to be refilled by a refill unit via a normally open outlet valve; and
the refill unit comprises:
a body containing a quantity of ink;
engagement formations for releasably engaging the ink storage compartment; and
an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a cartridge, wherein:
the ink storage compartment is arranged to be refilled by a refill unit; and
the refill unit comprises:
a body containing a quantity of ink;
an ink outlet; and
a repressurizing arrangement which, upon engagement of the refill unit with the ink storage compartment, causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and which, upon subsequent disengagement of the refill unit from the ink storage compartment, releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a cartridge, wherein:
the ink storage compartment has an interface for releasably engaging with a refill unit for refilling the ink storage compartment, the interface having valves for controlling ink flows into, and out of, the storage compartment; and
the refill unit comprises:
a body containing a quantity of ink;
an ink outlet; and,
valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a cartridge, further comprising an interface for releasably engaging a refill unit for refilling the cartridge,
wherein the inkjet printer incorporates a printhead, control circuitry and the refill unit, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

a memory circuit for storing information relating to at least one characteristic of the ink, which during use, allows the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a cartridge incorporating a printhead maintenance assembly for an inkjet printhead of the inkjet printer, the printhead having a nozzle plate with an array of nozzles formed therein,
wherein the printhead maintenance assembly comprises:

a capper to cover the array of nozzles when the printhead is not in use; and

a cleaner for engaging the nozzle plate and wiping across the nozzles, the cleaner being positioned between opposing sides of the capper.

In a further aspect there is provided a cartridge, wherein the inkjet printer comprises:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a cartridge, further comprising an interface for engaging an ink refill unit for replenishing the cartridge, the ink refill unit comprising:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement

formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

In a further aspect there is provided a cartridge, further comprising an interface for engaging an ink refill unit for replenishing the cartridge,
wherein the ink storage compartment is partially defined by a tubular flexible wall;
the cartridge further comprising a constriction mechanism for constricting the flexible tubular wall by a predetermined amount; and
the ink refill unit comprises:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a cartridge, further comprising a refill unit and an interface for engaging an ink refill unit for replenishing the cartridge, the ink refill unit comprising:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface,

wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a cartridge engageable with an ink refill unit for replenishing the cartridge, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a cartridge,
wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior;

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,
wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and
wherein the lid and the panel both open in the same direction.

In a further aspect there is provided a cartridge, wherein the inkjet printer comprises:
a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;
corresponding contacts for supplying the power and print data to the printhead contacts; and
a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a cartridge, wherein the inkjet printer comprises:
a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;
corresponding contacts for supplying the power and print data to the printhead contacts; and
a cover member for movement between open and closed positions, wherein, in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that, the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a cartridge, further comprising:
an ink feed system for supplying ink from the or each ink compartment to a printhead; and
a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a cartridge arranged to be held by a cradle within the inkjet printer, the cradle comprising a plurality of interfaces respectively corresponding to the storage compartments, each of the interfaces being configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a cartridge, wherein the printer incorporates a printhead comprising:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a cartridge, wherein the printer incorporates a printhead comprising:

a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;

a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and

a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits, polymer sealing film being more than 25 microns thick.

In a seventh aspect the present invention provides a refill unit for refilling an ink storage compartment with an interface
for releasably engaging with the refill unit, the interface having valves
for controlling ink flows into, and out of, the storage compartment, the
refill unit comprising:

a body containing a quantity of ink;
an ink outlet; and,
valve actuators for actuating the valves when the refill unit engages the
interface; such that,
the valve actuators actuate the valves in a predetermined sequence.

Actuating the valves in a predetermined sequence allows the refilling flow rates to be controlled and can isolate other parts of the ink feed system to the printhead which may affect the refilling process, or be affected by the refilling process. For example, it is useful to maintain the ink storage compartment at a negative pressure to prevent ink leakage from the printhead. However, during a

refilling process, the negative pressure may be temporarily removed and ink leakage may occur if the outlet valve to the printhead is not closed beforehand.

In some embodiments, the interface has a normally closed inlet valve for connection to the outlet of the refill, and a normally open ink outlet valve for connection to an inkjet printhead, wherein during use the valve actuators close the outlet valve before opening the inlet valve. Optionally, during use, the ink storage compartment maintains the ink at a negative pressure and the valve actuators do not actuate the inlet valve until the outlet of the refill has a sealed connection with the inlet valve. Optionally, the valve actuators comprise an inlet valve actuator and an outlet valve actuator, wherein the inlet valve actuator and the outlet valve actuator are both spigot-like projections with a tri-star cross section for robust bending resistance in all lateral directions. Optionally, the tri-star cross sections are configured to key into correspondingly shaped apertures in the interface to ensure the refill is matched to the correct ink storage compartment.

Optionally the interface has a normally closed inlet valve for connection to the outlet of the refill, and a normally open ink outlet valve for connection to an inkjet printhead, wherein during use the valve actuators close the outlet valve before opening the inlet valve.

Optionally during use, the ink storage compartment maintains the ink at a negative pressure and the valve actuators do not actuate the inlet valve until the outlet of the refill has a sealed connection with the inlet valve.

Optionally the valve actuators comprise an inlet valve actuator and an outlet valve actuator, wherein the inlet valve actuator and the outlet valve actuator are both spigot-like projections with a tri-star cross section for robust bending resistance in all lateral directions.

Optionally the tri-star cross sections are configured to key into correspondingly shaped apertures in the interface to ensure the refill is matched to the correct ink storage compartment.

In a further aspect there is provided a refill unit incorporated in a cartridge unit for an inkjet printer, the cartridge unit comprising:

the ink storage compartment and an ink feed system for connection to the printhead assembly with an array of ink ejection nozzles,

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a refill unit, wherein:
the ink storage compartment supplies ink to a printhead assembly;
the interface has an inlet valve biased to its closed configuration; and
the refill unit further comprises engagement formations for releasably engaging the interface and an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a refill unit, wherein:
the interface has a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment; and
the refill unit further comprises a docking portion having an ink outlet and valve actuator formations, which, during use, releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a refill unit, wherein:
the ink storage compartment supplies ink to a printhead assembly;
the refill unit interfaces with the ink storage compartment via a normally open outlet valve; and
the refill unit further comprises an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a refill unit, wherein:
the ink storage compartment supplies a printhead assembly with an array of nozzles, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;
the refill unit further comprises a repressurizing arrangement;
upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a refill unit incorporated in a cartridge for an inkjet printer, the cartridge comprising:
the ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to a printhead with an array of nozzles,
wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a refill unit for refilling an ink cartridge that forms part of an inkjet printer, the printer also having a printhead, control circuitry and an interface for releasably engaging the refill unit,
wherein the refill unit further comprises an ink outlet and a memory circuit for storing information relating to at least one characteristic of the ink, and
wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a refill unit incorporated in a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided a refill unit, wherein the printhead assembly is incorporated in an inkjet printer comprising:

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, wherein the refill unit further comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, and

wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, wherein:

the ink storage compartment is partially defined by a tubular flexible wall and has a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, and

the ink refill unit further comprises a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill unit,

wherein the ink refill unit comprises:

the ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, and

wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a refill unit for replenishing an ink cartridge in an inkjet printer, wherein the ink refill unit comprises:

the ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a refill unit incorporated in an inkjet printer comprising:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided a refill unit incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a refill unit incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a refill unit incorporated in a cartridge for an inkjet printer, the cartridge comprising:

at least one ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to a printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a refill unit incorporated in a cradle for holding an ink cartridge within an inkjet printer, the cartridge having a plurality of the ink storage compartments, the cradle comprising a plurality of the interfaces respectively corresponding to the ink storage compartments,

wherein each of the interfaces is configured to receive the ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a refill unit for replenishing ink to a printhead comprising:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a refill unit for replenishing ink to a printhead comprising:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In an eighth aspect the present invention provides a refill unit for refilling an ink cartridge that forms part of an inkjet printer, the printer also having a printhead, control circuitry and an interface for releasably engaging the refill unit, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and,

a memory circuit for storing information relating to at least one characteristic of the ink;

wherein during use,

the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

By incorporating information about the ink in the memory of an integrated circuit, the refill unit verifies its ink directly with the control circuitry in the printer to remove any scope for user error. In turn, this can extend the operational life of the printhead.

In some embodiments, the information includes the type and color of the ink. Optionally, the information includes the volume of ink in the refill unit. Optionally, the control circuit modifies the operation of the printhead in response to the information stored on the memory circuit. Optionally, the modified operation is an adjustment of the maximum print speed of the printhead.

Optionally the information includes the type and color of the ink.

Optionally the information includes the volume of ink in the refill unit.

Optionally the control circuit modifies the operation of the printhead in response to the information stored on the memory circuit.

Optionally the modified operation is an adjustment of the maximum print speed of the printhead.

In a further aspect there is provided a refill unit, wherein the cartridge comprises:

an ink storage compartment and an ink feed system for connection to the printhead which has an array of ink ejection nozzles, and

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead, the ink storage compartment having the interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration, wherein the further refill unit comprises:

engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a refill unit, wherein:

the ink cartridge has a negatively pressurized ink storage compartment that supplies ink to the printhead, and the interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment; and

the refill unit further comprises a docking portion having an ink outlet and valve actuator formations, wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead via a normally open outlet valve, wherein the refill unit further comprises:

engagement formations for releasably engaging the ink storage compartment; and

an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a refill unit for refilling an ink storage compartment supplying the printhead which has an array of nozzles, wherein:

during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;

the refill unit further comprises a repressurizing arrangement;

wherein upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a refill unit, wherein the cartridge comprises:

an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and

an ink feed system for supplying for supplying ink to a printhead with an array of nozzles, and

wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a refill unit for refilling an ink storage compartment having the interface for releasably engaging with the refill unit, the interface having valves for controlling ink flows into, and out of, the storage compartment,
wherein the refill unit further comprises valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a refill unit incorporated in printhead maintenance assembly for the printhead,
wherein the printhead has a nozzle plate with an array of nozzles formed therein; and
the printhead maintenance assembly comprises:

a capper to cover the array of nozzles when the printhead is not in use; and

a cleaner for engaging the nozzle plate and wiping across the nozzles, the cleaner being positioned between opposing sides of the capper.

In a further aspect there is provided a refill unit, wherein the inkjet printer comprises:

the printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a refill unit, wherein:
the ink cartridge has the interface for engaging the refill unit;
the refill unit further comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and
engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate; and
wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided a refill unit, wherein:

the ink cartridge has the interface for engaging the refill unit, an ink storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount; and

the refill unit further comprises a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a refill unit, wherein:

the ink cartridge has the interface for engaging the refill unit;

the ink refill unit comprises:

the ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface; and

wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a refill unit, wherein:

the ink outlet engages a complementary ink inlet in the cartridge; and

the refill unit further comprises a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a refill unit, wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

wherein the lid and the panel both open in the same direction.

In a further aspect there is provided a refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions, and

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a refill unit, wherein the cartridge comprises:

at least one ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to a printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a refill unit incorporated in a cradle for holding the ink cartridge within the inkjet printer, the cartridge having a plurality of ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments, wherein each of the interfaces is configured to receive the refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a refill unit, wherein the printhead comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a refill unit, wherein the printhead comprises:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a ninth aspect the present invention provides a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles; wherein,

the cleaner is positioned between opposing sides of the capper.

Housing the cleaner within the capper provides an elegantly compact design. Further, as the cleaner material is typically moist from absorbing ink, it can help to maintain a humid environment within the capper to avoid the nozzles drying out. Of course, the cleaner material may also be deliberately kept moistened for this purpose.
In some embodiments, both the capper and the cleaner are independently movable relative to the nozzle plate. Optionally, the cleaner is resiliently mounted to the capper so that while the capper can move perpendicularly relative to the nozzle plate, the cleaner can have limited movement parallel to the nozzle plate as well as perpendicular movement. Optionally, the capper and the cleaner are actuated by a single motor drive. Optionally, the motor drive actuates the capper and the cleaner via separate cam shafts.

Optionally both the capper and the cleaner are independently movable relative to the nozzle plate.

Optionally the cleaner is resiliently mounted to the capper so that while the capper can move perpendicularly relative to the nozzle plate, the cleaner can have limited movement parallel to the nozzle plate as well as perpendicular movement.

Optionally the capper and the cleaner are actuated by a single motor drive.

Optionally the motor drive actuates the capper and the cleaner via separate cam shafts.

In a further aspect there is provided an assembly incorporated in a cartridge unit for an inkjet printer, the cartridge unit comprising an ink storage compartment and an ink feed system for connection to the printhead,
wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided an assembly incorporating a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead, the ink storage compartment having an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration, the refill unit comprising:

a body containing a quantity of ink;
engagement formations for releasably engaging the interface; and
an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided an assembly incorporating a refill unit for an ink cartridge, the ink cartridge having a negatively pressurized ink storage compartment that supplies ink to the printhead, and an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment, the refill unit comprising:
a body containing a quantity of ink;
a docking portion having an ink outlet and valve actuator formations,
wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided an assembly incorporating a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead via a normally open outlet valve, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the ink storage compartment; and

an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided an assembly incorporating a refill unit for refilling an ink storage compartment supplying the printhead, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

a repressurizing arrangement,

wherein upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided an assembly incorporated in an ink cartridge for an inkjet printer, the cartridge comprising:

an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and

an ink feed system for supplying for supplying ink to the printhead,

wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided an assembly incorporating a refill unit for refilling an ink storage compartment with an interface for releasably engaging with the refill unit, the interface having valves for controlling ink flows into, and out of, the storage compartment, the refill unit comprising:

a body containing a quantity of ink;
an ink outlet; and
valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided an assembly incorporating a refill unit for refilling an ink cartridge that forms part of an inkjet printer, the printer also having the printhead, control circuitry and an interface for releasably engaging the refill unit, the refill unit comprising:
a body containing a quantity of ink;
an ink outlet; and
a memory circuit for storing information relating to at least one characteristic of the ink,
wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided an assembly incorporated in an inkjet printer comprising:
the printhead; and
a motorized drive for moving the maintenance assembly between a capped position where the assembly covers the array of nozzles and an uncapped position spaced from the array of nozzles.

In a further aspect there is provided an assembly incorporating an ink refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:
an ink storage compartment;
a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and
engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate,
wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided an assembly incorporating an ink refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill, an ink storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, the ink refill unit comprising:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided an assembly incorporating an ink refill unit for replenishing an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided an assembly incorporating an ink refill unit for replenishing an ink cartridge in an inkjet printer, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided an assembly incorporated in an inkjet printer comprising:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed, wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided an assembly incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided an assembly incorporated in an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided an assembly incorporated in a cartridge for an inkjet printer, the cartridge comprising:

at least one ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to a printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided an assembly incorporated in a cradle for holding an ink cartridge within an inkjet printer, the cartridge having a plurality of ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments, wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided an assembly, wherein the printhead comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided an assembly, wherein the printhead comprises:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a tenth aspect the present invention provides an inkjet printer comprising:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and,

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position; wherein
the maintenance assembly has a capper for covering the array and a cleaner for wiping the array, such that the motorized drive uses a cam shaft arrangement for moving the cleaner relative to the capper.

Using a single motor to actuate both the capper and the cleaner the printhead provides a compact design and simplifies the electrical systems within the printer.

In some embodiments, the cleaner is positioned between opposing sides of the capper. Optionally, both the capper and the cleaner are independently movable relative to the array of nozzles. Optionally, the cleaner wipes across the nozzles as the maintenance assembly moves from the capped position to the uncapped position. Optionally, the printhead is a pagewidth printhead, the array of nozzles is elongated
and the cleaner is likewise elongated; wherein,

the motorized drive wipes the cleaner longitudinally across the nozzles.

Optionally the cleaner is positioned between opposing sides of the capper.

Optionally both the capper and the cleaner are independently movable relative to the array of nozzles.

Optionally the cleaner wipes across the nozzles as the maintenance assembly moves from the capped position to the uncapped position.

Optionally the printhead is a pagewidth printhead, the array of nozzles is elongated and the cleaner is likewise elongated; wherein,

the motorized drive wipes the cleaner longitudinally across the nozzles.

In a further aspect there is provided a printer, further comprising a cartridge unit comprising an ink storage compartment and an ink feed system for connection to the printhead,
wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a printer, further comprising a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead, the ink storage compartment having an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration, the refill unit comprising:

a body containing a quantity of ink;
engagement formations for releasably engaging the interface; and
an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a printer, further comprising an ink refill unit for an ink cartridge, the ink cartridge having a negatively pressurized ink storage compartment that supplies ink to the printhead, and an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment, the refill unit comprising:
a body containing a quantity of ink;
a docking portion having an ink outlet and valve actuator formations,
wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a printer, further comprising a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead via a normally open outlet valve, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the ink storage compartment; and

an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a printer, further comprising a refill unit for refilling an ink storage compartment supplying the printhead, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

a repressurizing arrangement,

wherein upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a printer, further comprising an ink cartridge comprising:

an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and

an ink feed system for supplying for supplying ink to a printhead with an array of nozzles,

wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a printer, further comprising a refill unit for refilling an ink storage compartment with an interface for releasably engaging with the refill unit, the interface

having valves for controlling ink flows into, and out of, the storage compartment, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a printer, further comprising a refill unit for refilling an ink cartridge that forms part of the printer, the printer also having control circuitry and an interface for releasably engaging the refill unit, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

a memory circuit for storing information relating to at least one characteristic of the ink,

wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a printer, further comprising a printhead maintenance assembly for the printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided a printer, further comprising an ink refill unit for replenishing an ink cartridge in the printer, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate,

wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided a printer, further comprising an ink refill unit for replenishing an ink cartridge in the printer, the ink cartridge having an interface for engaging the ink refill, an ink storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, the ink refill unit comprising:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a printer, further comprising an ink refill unit for replenishing an ink cartridge in the printer, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a printer, further comprising an ink refill unit for replenishing an ink cartridge in the printer, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a printer, , further comprising:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed, wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided a printer, further comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a printer, further comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a printer, further comprising a cartridge comprising:

at least one ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to a printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a printer, further comprising a cradle for holding an ink cartridge within the printer, the cartridge having a plurality of ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments,

wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a printer, wherein the printhead comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a printer, wherein the printhead comprises:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In an eleventh aspect the present invention provides an ink refill unit for replenishing an ink cartridge in an inkjet printer,
the ink cartridge having an interface for engaging the ink refill unit, the
ink refill unit comprising:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface;

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate;
wherein,

the centre of the ink outlet is spaced from the transverse centre line.

Offsetting the ink outlet from the centre line of the base plate provides a significant visual indicator to the user as to the correct orientation of the refill for engagement with the cartridge. If ink outlet were in the centre of the base plate, there is a significant chance that a user will try installing the refill 180° out of the correct orientation. As the ink outlet is a large feature on the base of the refill, offsetting it to one side has a greater visual impact than the other features on the base plate would.

In some embodiments,the ink cartridge has an ink storage compartment partially defined by a tubular flexible wall, and a constrictor mechanism for constricting the flexible tubular wall by a predetermined amount, and the docking

portion having a plurality of constrictor actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface. Optionally, the base plate has a spigot projecting therefrom for insertion into an aperture in the interface, the spigot having a cross section that is keyed to the shape of the aperture to ensure that the refill is correctly match to the cartridge. Optionally, the spigot has a tri-star cross section. Optionally, the spigot actuates a valve in the cartridge when the refill engages the interface.

Optionally the ink cartridge has an ink storage compartment partially defined by a tubular flexible wall, and a constrictor mechanism for constricting the flexible tubular wall by a predetermined amount, and the docking portion having a plurality of constrictor actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

Optionally the base plate has a spigot projecting therefrom for insertion into an aperture in the interface, the spigot having a cross section that is keyed to the shape of the aperture to ensure that the refill is correctly match to the cartridge.

Optionally the spigot has a tri-star cross section.

Optionally the spigot actuates a valve in the cartridge when the refill engages the interface.

In a further aspect there is provided an ink refill unit, wherein:
the cartridge comprises an ink storage compartment and an ink feed system for connection to a printhead assembly with an array of ink ejection nozzles; and
the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided an ink refill unit, wherein:

the cartridge comprises a negatively pressurized ink storage compartment that supplies ink to a printhead assembly, the ink storage compartment having an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration; and

the refill unit further comprises:

a body containing a quantity of ink; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided an ink refill unit, wherein:

the ink cartridge has a negatively pressurized ink storage compartment that supplies ink to a printhead assembly, and an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment;

the refill unit further comprises:

a body containing a quantity of ink; and

the docking portion having the ink outlet and valve actuator formations; and

wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided an ink refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to a printhead assembly via a normally open outlet valve, the refill unit further comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the ink storage compartment; and

an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided an ink refill unit for refilling an ink storage compartment supplying a printhead assembly with an array of nozzles, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles, the refill unit further comprising:

a body containing a quantity of ink;

an ink outlet; and

a repressurizing arrangement,

wherein upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided an ink refill unit, wherein:

the cartridge comprises:

an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and

an ink feed system for supplying for supplying ink to a printhead with an array of nozzles; and

one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided an ink refill unit for refilling an ink storage compartment with an interface for releasably engaging with the refill unit, the interface having valves for controlling ink flows into, and out of, the storage compartment, the refill unit further comprising:

a body containing a quantity of ink;

an ink outlet; and

valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided an ink refill unit, wherein:

the cartridge forms part of the inkjet printer, the printer also having a printhead, control circuitry and an interface for releasably engaging the refill unit;

the refill unit further comprises:

a body containing a quantity of ink;

an ink outlet; and

a memory circuit for storing information relating to at least one characteristic of the ink; and

during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided an ink refill unit incorporated in a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided an ink refill unit, wherein:

the ink cartridge has an ink storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount; and

the ink refill unit comprises:

a body containing a quantity of ink; and

the docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided an ink refill unit, further comprising:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface,

wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided an ink refill unit, further comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed, wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions, and

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided an ink refill unit, wherein the cartridge comprises:

at least one ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to a printhead; and
a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided an ink refill unit incorporated in a cradle for holding the ink cartridge within the inkjet printer, the cartridge having a plurality of ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments,
wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided an ink refill unit, wherein the printer has a printhead comprising:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided an ink refill unit, wherein the printer has a printhead comprising:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a twelfth aspect the present invention provides an ink refill unit for replenishing an ink cartridge in an inkjet printer,
the ink cartridge having an interface for engaging the ink refill, an ink storage compartment partially defined by a tubular flexible wall, and a constrictor mechanism for constricting the flexible tubular wall by a predetermined amount, the ink refill unit comprising:

a body containing a quantity of ink;

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constrictor actuators for actuating the constrictor mechanism as the ink refill unit engages the interface and releases the constrictor mechanism as the ink refill unit disengages the interface.

The ink storage compartment is maintained at a negative pressure to avoid ink leakage from the printhead. However, during an ink refill process, the negative pressure is removed when the ink storage volume is filled to capacity. Without the negative pressure in the ink storage compartment, there is a high risk of ink leakage. By slightly increasing the compartment's capacity as soon as the refill is disengaged, the negative pressure is re-established. Depressing a part of the ink storage compartment during refilling will reduce its volume. However, when the refill unit releases the depressed part, the capacity is correspondingly increased and negative pressure is re-established. By providing the actuators for the constrictor mechanism on the refill, the application and release of the constrictor mechanism will always occur and at precisely the correct times during the refilling process.

In some embodiments, the constrictor actuators are positioned on the docking portion such that they are at the corners of a regular sided geometric shape. Optionally, the constrictor actuators are generally flat pegs extending from the docking portion such that the plane of each peg crosses the corresponding diagonal of the square at right angles. Optionally, the pegs are slightly arcuate with their respective centers of curvature proximate the centre of the square. Optionally, each of the pegs have a buttress reinforcement extending along the corresponding diagonal and towards the centre of the square.

Optionally the constrictor actuators are positioned on the docking portion such that they are at the corners of a regular sided geometric shape.

Optionally the constrictor actuators are generally flat pegs extending from the docking portion such that the plane of each peg crosses the corresponding diagonal of the square at right angles.

Optionally the pegs are slightly arcuate with their respective centres of curvature proximate the centre of the square.

Optionally each of the pegs have a buttress reinforcement extending along the corresponding diagonal and towards the centre of the square.

In a further aspect there is provided an ink refill unit, wherein:
the cartridge comprises an ink feed system for connection to a printhead assembly with an array of ink ejection nozzles; and
the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided an ink refill unit, wherein:
the ink storage compartment is negatively pressurized, supplies ink to a printhead assembly, and has an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration; and
the refill unit further comprises engagement formations for releasably engaging the interface and an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided an ink refill unit, wherein:
the ink storage compartment is negatively pressurized and supplies ink to a printhead assembly;
the cartridge has an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment; and
the docking portion has valve actuator formations, wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided an ink refill unit, wherein:
the ink storage compartment is negatively pressurized ink storage and supplies ink to a printhead assembly via a normally open outlet valve; and

the refill unit further comprises engagement formations for releasably engaging the ink storage compartment and an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided an ink refill unit, wherein:
the ink storage compartment supplies a printhead assembly with an array of nozzles, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;
the refill unit further comprises an ink outlet and a repressurizing arrangement;
upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided an ink refill unit, wherein the cartridge comprises:
the ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to a printhead with an array of nozzles, and wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided an ink refill unit, wherein:
the interface releasably engages with the refill unit and has valves for controlling ink flows into, and out of, the storage compartment; and
the refill unit further comprises an ink outlet and valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided an ink refill unit, wherein:
the ink cartridge forms part of the inkjet printer which has a printhead, control circuitry and an interface for releasably engaging the refill unit;

the refill unit further comprises an ink outlet and a memory circuit for storing information relating to at least one characteristic of the ink; and

during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided an ink refill unit incorporated in a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided an ink refill unit, wherein:

the refill unit further comprises an ink storage compartment;

the docking portion has a base plate with the ink outlet for connection to the inlet port on the interface; and

the refill unit further comprises engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

In a further aspect there is provided an ink refill unit, further comprising:

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface,

wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided an ink refill unit, further comprising:

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed, wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided an ink refill unit, wherein the cartridge comprises:

at least one ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to a printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided an ink refill unit incorporated in a cradle for holding the ink cartridge within the inkjet printer, the cartridge having a plurality of the ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments,
wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided an ink refill unit for refilling a printhead comprising:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided an ink refill unit for refilling a printhead of the inkjet printer, the printhead comprising:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a thirteenth aspect the present invention provides an ink refill unit for replenishing an ink cartridge in an inkjet printer,
the ink cartridge having an interface for engaging the ink refill unit, the
ink refill unit comprising:

a body containing a quantity of ink; and,

an ink outlet for engaging an ink inlet in the interface; wherein

a feature of the ink refill unit and a feature of the interface form a pair of complementary features that have a keyed connection with each other when the ink refill unit engages the interface.

In some embodiments, the pair of complementary features comprises a spigot extending from the body for insertion in an aperture in the interface; wherein,

the lateral cross section of the spigot is keyed to the shape defined by the aperture. Optionally, the base plate has a spigot projecting therefrom for insertion into an aperture in the interface, the spigot having a cross section that is keyed to the shape of the aperture to ensure that the refill is correctly match to the cartridge. Optionally, the spigot has a tri-star cross section. Optionally, the spigot actuates a valve in the cartridge when the refill engages the interface.

Optionally the pair of complementary features comprises a spigot extending from the body for insertion in an aperture in the interface; wherein,

the lateral cross section of the spigot is keyed to the shape defined by the aperture.

Optionally the spigot has a tri-star cross section.

Optionally the spigot is tapered.

Optionally the spigot actuates a valve in the cartridge when the refill engages the interface.

In a further aspect there is provided an ink refill unit, wherein:
the cartridge comprises an ink feed system for connection to a printhead assembly with an array of ink ejection nozzles; and
the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided an ink refill unit, wherein:
the ink storage compartment is negatively pressurized, supplies ink to a printhead assembly, and has an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration; and

the refill unit further comprises engagement formations for releasably engaging the interface and an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided an ink refill unit, wherein:
the ink storage compartment is negatively pressurized and supplies ink to a printhead assembly;
the cartridge has an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment; and
a docking portion having an ink outlet and valve actuator formations, wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided an ink refill unit, wherein:
the ink storage compartment is negatively pressurized ink storage and supplies ink to a printhead assembly via a normally open outlet valve; and
the refill unit further comprises engagement formations for releasably engaging the ink storage compartment and an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided an ink refill unit, wherein:
the ink storage compartment supplies a printhead assembly with an array of nozzles, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;
the refill unit further comprises an ink outlet and a repressurizing arrangement;
upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided an ink refill unit, wherein the cartridge comprises:

the ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to a printhead with an array of nozzles, and
wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided an ink refill unit, wherein:
the interface releasably engages with the refill unit and has valves for controlling ink flows into, and out of, the storage compartment; and
the refill unit further comprises an ink outlet and valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided an ink refill unit, wherein:
the ink cartridge forms part of the inkjet printer which has a printhead, control circuitry and an interface for releasably engaging the refill unit;
the refill unit further comprises an ink outlet and a memory circuit for storing information relating to at least one characteristic of the ink; and
during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided an ink refill unit incorporated in a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped

position and the uncapped position.

In a further aspect there is provided an ink refill unit, further comprising:
an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with the ink outlet for connection to the ink inlet on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

In a further aspect there is provided an ink refill unit, further comprising:

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,
wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,
wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided an ink refill unit, wherein the cartridge comprises:
at least one ink storage compartment;
an ink feed system for supplying ink from the or each ink compartment to a printhead; and
a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided an ink refill unit incorporated in a cradle for holding the ink cartridge within the inkjet printer, the cartridge having a plurality of the ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments,
wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided an ink refill unit for refilling a printhead comprising:
a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;
an integrated circuit support structure for mounting in the printer adjacent a media feed path; and
a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided an ink refill unit for refilling a printhead of the inkjet printer, the printhead comprising:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and

a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a fourteenth aspect the present invention provides an ink refill unit for replenishing an ink cartridge in an inkjet printer,
the
ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and,

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

This can be used to warn users that the refill will soon be empty so they can obtain a new one, or that the refill is completely empty and should be removed from the cartridge, or indeed that the refill is full. It will be appreciated that a similar ink level indicator can be used to indicate the level of ink in a cartridge and not just a refill unit.
In some embodiments, the body has a flexible bag for storing the ink, and the visual indicator is a strip of flexible material fixed to the flexible bag and slidingly retained on a rigid part of the body so that when the flexible bag collapses as the ink is used, the strip slides relative to the rigid part of the body. Optionally, the visual indication is a differently colored part of the strip as it slides past a point on the rigid part of the body. Optionally, both ends of the strip are fixed to the flexible bag and retained for sliding past a window in the rigid part of the body, so that the visual indication is the differently colored part appearing in the window. Optionally, the visual indication is an indication that the refill unit is empty.

Optionally the body has a flexible bag for storing the ink, and the visual indicator is a strip of flexible material fixed to the flexible bag and slidingly retained on a rigid part of the body so that when the flexible bag collapses as the ink is used, the strip slides relative to the rigid part of the body.

Optionally the visual indication is a differently colored part of the strip as it slides past a point on the rigid part of the body.

Optionally both ends of the strip are fixed to the flexible bag and retained for sliding past a window in the rigid part of the body, so that the visual indication is the differently colored part appearing in the window.

Optionally the visual indication is an indication that the refill unit is empty.
Fig. 51C To accompany the abstract.

In a further aspect there is provided an ink refill unit, wherein:
the cartridge comprises an ink storage compartment and an ink feed system for connection to a printhead assembly with an array of ink ejection nozzles; and
the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided an ink refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to a printhead assembly, the ink storage compartment having an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration, wherein the refill unit further comprises:
engagement formations for releasably engaging the interface; and
an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided an ink refill unit, wherein:
the ink cartridge has a negatively pressurized ink storage compartment that supplies ink to a printhead assembly, and an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment; and
the refill unit further comprises a docking portion having an ink outlet and valve actuator formations, wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided an ink refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to a printhead assembly via a normally open outlet valve, wherein the refill unit further comprises:
engagement formations for releasably engaging the ink storage compartment; and
an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided an ink refill unit for refilling an ink storage compartment supplying a printhead assembly with an array of nozzles, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles, wherein the refill unit further comprises a repressurizing arrangement,
upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided an ink refill unit, wherein the cartridge comprises:
an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to a printhead with an array of nozzles, and
wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided an ink refill unit for refilling an ink storage compartment with an interface for releasably engaging with the refill unit, the interface having valves for controlling ink flows into, and out of, the storage compartment,
wherein the refill unit further comprises valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided an ink refill unit, wherein:

the ink cartridge forms part of the inkjet printer which has a printhead, control circuitry and an interface for releasably engaging the refill unit;
the refill unit further comprises a memory circuit for storing information relating to at least one characteristic of the ink; and
during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided an ink refill unit incorporated in a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided an ink refill unit, wherein:
the ink cartridge has an interface for engaging the ink refill unit; and
the ink refill unit further comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and
engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

In a further aspect there is provided an ink refill unit, wherein:

the ink cartridge has an interface for engaging the ink refill, an ink storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount; and

the ink refill unit further comprises a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided an ink refill unit, wherein:

the ink cartridge has an interface for engaging the ink refill unit; and

the ink refill unit further comprises a spigot extending from the body for insertion in an aperture in the interface, the lateral cross section of the spigot being keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided an ink refill unit, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided an ink refill unit, wherein the cartridge comprises:
at least one ink storage compartment;
an ink feed system for supplying ink from the or each ink compartment to a printhead; and
a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided an ink refill unit incorporated in a cradle for holding the ink cartridge within the inkjet printer, the cartridge having a plurality of ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments,
wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided an ink refill unit for refilling a printhead comprising:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided an ink refill unit for refilling a printhead of the inkjet printer, the printhead comprising:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,

wherein polymer sealing film is more than 25 microns thick.

In a fifteenth aspect the present invention provides an inkjet printer comprising:

an outer casing with a hingedly mounted panel for access its interior;

a cradle housed within the outer casing for supporting an ink cartridge,

the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed; wherein,

the hinge axis of the lid and the hinge axis of the panel are parallel;

and,

the lid and the panel both open in the same direction.

If both the lid and the panel open in the same direction, the user has relatively unobstructed access to the interior of the cradle. If the lid and the panel were to open in opposite directions, they would form a deep 'canyon' into which the user would need to install the cartridge. In this case the tendancy would be to drop the cartridge into place which could damage the printhead.
In some preferred embodiments, the lid and the panel open towards the back of the printer. Optionally, the front wall of the cradle rotates away from the back wall to further expose the interior of the cradle. Optionally, the front wall is drawn back towards the back wall of the cradle as the lid is closed. Optionally, the lid has a series of refill interfaces.

Optionally the lid and the panel open towards the back of the printer.

Optionally the front wall of the cradle rotates away from the back wall to further expose the interior of the cradle.

Optionally the front wall is drawn towards the back wall of the cradle as the lid is closed.

Optionally the lid has a series of refill interfaces.

In a further aspect there is provided an inkjet printer, wherein:
the cartridge comprises an ink storage compartment and an ink feed system for connection to a printhead assembly with an array of ink ejection nozzles; and

the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to a printhead assembly, the ink storage compartment having an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for the ink cartridge, the ink cartridge having a negatively pressurized ink storage compartment that supplies ink to a printhead assembly, and an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment, the refill unit comprising:

a body containing a quantity of ink;

a docking portion having an ink outlet and valve actuator formations,

wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to a printhead assembly via a normally open outlet valve, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the ink storage compartment; and

an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling an ink storage compartment supplying a printhead assembly with an array of nozzles, wherein during

use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

a repressurizing arrangement,

wherein upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided an inkjet printer, wherein the cartridge comprises:

an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and

an ink feed system for supplying for supplying ink to a printhead with an array of nozzles, one of the opposed wall sections being displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling an ink storage compartment with an interface for releasably engaging with the refill unit, the interface having valves for controlling ink flows into, and out of, the storage compartment, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling the ink cartridge that forms part of the inkjet printer, wherein:

the printer further comprises a printhead, control circuitry and an interface for releasably engaging the refill unit; and

the refill unit comprises:
a body containing a quantity of ink;
an ink outlet; and
a memory circuit for storing information relating to at least one characteristic of the ink, wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided an inkjet printer, further comprising a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided an inkjet printer, further comprising:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing the ink cartridge, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate,

wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing the ink cartridge, the ink cartridge having an interface for engaging the ink refill, an ink

storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, the ink refill unit comprising:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing the ink cartridge, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing the ink cartridge, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided an inkjet printer, further comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided an inkjet printer, further comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided an inkjet printer, wherein the cartridge comprises:
at least one ink storage compartment;
an ink feed system for supplying ink from the or each ink compartment to a printhead; and
a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided an inkjet printer, further comprising a cradle for holding the ink cartridge within the inkjet printer, the cartridge having a plurality of ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments,
wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising a printhead comprising:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided an inkjet printer, further comprising a printhead comprising:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and

a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a sixteenth aspect the present invention provides an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles; and,

corresponding contacts for supplying the power and print data to the printhead contacts; and,

a selective biasing mechanism; such that,

the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

Pagewidth inkjet printers will typically have many electrical contacts along its length for sending power and control signals to the nozzles. For an effective electrical connection, the pressure on each contact should be reasonably high. This pressure is often provided by an interference fit between the printhead contact and the power/data contacts. However, if this pressure is multiplied by the number of contacts along the pagewidth printhead, the force required to install the printhead could cause damage. By configuring one set of the contacts to be movable, the printhead can be installed and then the require contact pressure applied without risk of damage to the printhead.
In some embodiments, the printer has a cradle with a lid, and the printhead sits in the cradle during use. Optionally, the lid moves the corresponding contacts into and out of biased engagement with the printhead contacts. Optionally, the printhead is a pagewidth printhead and the printhead contacts extend along its length. Optionally, the lid uses a lever mechanism to achieve the required pressure between the contacts.

Optionally the inkjet printer further comprises a cradle with a lid, and the printhead sits in the cradle during use.

Optionally the lid moves the corresponding contacts into and out of biased engagement with the printhead contacts.

Optionally the printhead is a pagewidth printhead and the printhead contacts extend along its length.

Optionally the lid uses a lever mechanism to achieve the required pressure between the contacts.

In a further aspect there is provided an inkjet printer, further comprising a cartridge unit for an inkjet printer, the cartridge unit comprising:

an ink storage compartment and an ink feed system for connection to the printhead,

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead, the ink storage compartment having an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for an ink cartridge, the ink cartridge having a negatively pressurized ink storage compartment that supplies ink to the printhead, and an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment, the refill unit comprising:

a body containing a quantity of ink;

a docking portion having an ink outlet and valve actuator formations,

wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead via a normally open outlet valve, the refill unit comprising:

a body containing a quantity of ink;
engagement formations for releasably engaging the ink storage compartment; and
an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling an ink storage compartment supplying the printhead, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles, the refill unit comprising:

a body containing a quantity of ink;
an ink outlet; and

a repressurizing arrangement,
wherein upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided an inkjet printer, further comprising an ink cartridge comprising:
an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to the printhead,
wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling an ink storage compartment with an interface for releasably engaging with the refill unit, the interface having valves for controlling ink flows into, and out of, the storage compartment, the refill unit comprising:

a body containing a quantity of ink;
an ink outlet; and

valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling an ink cartridge that forms part of the inkjet printer, the printer also having control circuitry and an interface for releasably engaging the refill unit, the refill unit comprising:
a body containing a quantity of ink;
an ink outlet; and
a memory circuit for storing information relating to at least one characteristic of the ink,
wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided an inkjet printer, further comprising a printhead maintenance assembly for the printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided an inkjet printer, further comprising:

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate,

wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging the ink refill, an ink storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, the ink refill unit comprising:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing an ink cartridge in the inkjet printer, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided an inkjet printer, further comprising:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed, wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided an inkjet printer, further comprising a cover member for movement between open and closed positions,
wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided an inkjet printer, further comprising a cartridge comprising:
at least one ink storage compartment;
an ink feed system for supplying ink from the or each ink compartment to a printhead; and
a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided an inkjet printer, further comprising a cradle for holding an ink cartridge within the inkjet printer, the cartridge having a plurality of ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments,
wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided an inkjet printer, wherein the printhead comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided an inkjet printer, wherein the printhead comprises:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and

a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a seventeenth aspect the present invention provides an inkjet printer comprising:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles; and,

corresponding contacts for supplying the power and print data to the printhead contacts; and,

a cover member for movement between open and closed positons; wherein,

in the open position, the printhead can be installed or removed, and the cover member is in the closed position during printing; such that,

the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed position, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open position.

By breaking the contacts prior to removal of the printhead, cradle contact wear is avoided. Worn contacts can compromise the
power/data transmission to subsequently installed printheads. It also allows controlled voltage application to the printhead. The contacts can be configured to be broken in a particular sequence.

In some embodiments, the cover member is a lid on a cradle in which the printhead sits during use. Optionally, the lid moves the corresponding contacts into and out of biased engagement with the printhead contacts. Optionally, the printhead is a pagewidth printhead and the printhead contacts extend along its length. Optionally, the lid uses a lever mechanism to disengage the contacts.

Optionally the cover member is a lid on a cradle in which the printhead sits during use.

Optionally the lid moves the corresponding contacts into and out of biased engagement with the printhead contacts.

Optionally the printhead is a pagewidth printhead and the printhead contacts extend along its length.

Optionally the lid uses a lever mechanism to disengage the contacts.

In a further aspect there is provided an inkjet printer, further comprising a cartridge unit for an inkjet printer, the cartridge unit comprising:

an ink storage compartment and an ink feed system for connection to the printhead,

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead, the ink storage compartment having an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for an ink cartridge, the ink cartridge having a negatively pressurized ink storage compartment that supplies ink to the printhead, and an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment, the refill unit comprising:

a body containing a quantity of ink;

a docking portion having an ink outlet and valve actuator formations,

wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling a negatively pressurized ink storage compartment that supplies ink to the printhead via a normally open outlet valve, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the ink storage compartment; and
an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling an ink storage compartment supplying the printhead, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

a repressurizing arrangement,

wherein upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization, and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided an inkjet printer, further comprising an ink cartridge comprising:
an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to the printhead,
wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling an ink storage compartment with an interface for releasably engaging with the refill unit, the interface having valves for controlling ink flows into, and out of, the storage compartment, the refill unit comprising:

a body containing a quantity of ink;

an ink outlet; and

valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided an inkjet printer, further comprising a refill unit for refilling an ink cartridge that forms part of the inkjet printer, the printer also having control circuitry and an interface for releasably engaging the refill unit, the refill unit comprising:
a body containing a quantity of ink;
an ink outlet; and
a memory circuit for storing information relating to at least one characteristic of the ink,
wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided an inkjet printer, further comprising a printhead maintenance assembly for the printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided an inkjet printer, further comprising:

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate,

wherein the centre of the ink outlet is spaced from the transverse centre line.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging the ink refill, an ink storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, the ink refill unit comprising:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging the ink refill unit, the ink refill unit comprising:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided an inkjet printer, further comprising an ink refill unit for replenishing an ink cartridge in the inkjet printer, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided an inkjet printer, further comprising:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed, wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided an inkjet printer, further comprising a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided an inkjet printer, further comprising a cartridge comprising:
at least one ink storage compartment;
an ink feed system for supplying ink from the or each ink compartment to a printhead; and
a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided an inkjet printer, further comprising a cradle for holding an ink cartridge within the inkjet printer, the cartridge having a plurality of ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments,
wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided an inkjet printer, wherein the printhead comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided an inkjet printer, wherein the printhead comprises:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In an eighteenth aspect the present invention provides a cartridge for an inkjet printer, the cartridge comprising:
at least one ink storage compartment;
an ink feed system for supplying ink from the or each ink compartment to a printhead; and,
a maintenance station for engaging the printhead to perform one or more maintenance functions.
In some embodiments, the printhead has an array of nozzles, and the maintenance station has a capper for capping the array of nozzles and a cleaner for cleaning the printhead, the cleaner being positioned between opposing sides of the capper. Optionally, both the capper and the cleaner are independently movable relative to the array of nozzles. Optionally, the cleaner wipes across the array of nozzles as the maintenance assembly moves from
a capped position to an uncapped position. Optionally, the printhead is a pagewidth printhead, the array of nozzles is elongated
and the cleaner is likewise elongated; wherein the motorized drive wipes the cleaner longitudinally across the nozzles.

Optionally the printhead has an array of nozzles, and the maintenance station has a capper for capping the array of nozzles and a cleaner for cleaning the printhead, the cleaner being positioned between opposing sides of the capper.

Optionally both the capper and the cleaner are independently movable relative to the array of nozzles.

Optionally the cleaner wipes across the array of nozzles as the maintenance assembly moves from a capped position to an uncapped position.

Optionally the printhead is a pagewidth printhead, the array of nozzles is elongated
and the cleaner is likewise elongated; wherein,
a motorized drive actuates both the capper and the cleaner.
In a further aspect there is provided a cartridge, wherein:
the printhead has an array of ink ejection nozzles; and
the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a cartridge, wherein the ink storage compartment is arranged to be negatively pressurized and to receive a refill unit for refilling the ink storage compartment, the ink storage compartment having an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a cartridge, wherein:

the ink storage compartment is arranged to be negatively pressurized;

the cartridge further comprises an interface for receiving a refill unit for refilling the ink storage compartment, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment; and

the refill unit comprises a body containing a quantity of ink and a docking portion having an ink outlet and valve actuator formations; and

during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a cartridge, wherein the ink storage compartment is arranged to be negatively pressurized and to receive a refill unit for refilling the ink storage compartment via a normally open outlet valve, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the ink storage compartment; and

an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a cartridge, wherein:

the ink storage compartment is arranged to receive a refill unit for refilling the ink storage compartment;

the printhead has an array of nozzles, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;

the refill unit comprises a body containing a quantity of ink, an ink outlet and a repressurizing arrangement;
upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a cartridge, wherein:
the ink storage compartment has opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume;
the printhead has an array of nozzles; and
one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a cartridge, wherein:
the ink storage compartment has an interface for releasably engaging with a refill unit for refilling the ink storage compartment, the interface having valves for controlling ink flows into, and out of, the storage compartment; and
the refill unit comprises a body containing a quantity of ink, an ink outlet and valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a cartridge, wherein:
the cartridge is arranged to form part of the inkjet printer and to receive a refill unit for refilling the cartridge;
the printer has the printhead, control circuitry and an interface for releasably engaging the refill unit; and
the refill unit comprises a body containing a quantity of ink, an ink outlet and a memory circuit for storing information relating to at least one characteristic of the ink, wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a cartridge incorporating a printhead maintenance assembly for the printhead, wherein:
the printhead has a nozzle plate with an array of nozzles formed therein; and
the printhead maintenance assembly comprises:
a capper to cover the array of nozzles when the printhead is not in use; and,
a cleaner for engaging the nozzle plate and wiping across the nozzles, the cleaner being positioned between opposing sides of the capper.

In a further aspect there is provided a cartridge, wherein the inkjet printer comprises:
the printhead which has an array of nozzles;
a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and
a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a cartridge, further comprising an interface for engaging an ink refill unit for replenishing the cartridge, wherein the ink refill unit comprises:
an ink storage compartment;
a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and
engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

In a further aspect there is provided a cartridge, further comprising an interface for engaging an ink refill unit for replenishing the cartridge, wherein:
the ink storage compartment is partially defined by a tubular flexible wall;
the cartridge further comprises a constriction mechanism for constricting the flexible tubular wall by a predetermined amount; and
the ink refill unit comprises a body containing a quantity of ink and a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as

the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a cartridge, further comprises an interface for engaging an ink refill unit for replenishing the cartridge, the ink refill unit comprising:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface,

wherein the lateral cross section of the spigot is keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a cartridge arranged to receive an ink refill unit for replenishing the cartridge, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a cartridge, wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided a cartridge, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a cartridge, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions,

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a cartridge incorporated in a cradle for holding the cartridge within the inkjet printer, wherein:

the cartridge has a plurality of the ink storage compartments;

the cradle comprises a plurality of interfaces respectively corresponding to the ink storage compartments; and

each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a cartridge, wherein the printhead comprises:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a cartridge, wherein the printhead comprises:

a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;

a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and

a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,

wherein polymer sealing film is more than 25 microns thick.

In a nineteenth aspect the present invention provides a cradle for holding an ink cartridge within an inkjet printer, the
cartridge having a plurality of ink storage compartments, the cradle
comprising:

a plurality of interfaces respectively corresponding to the ink storage
compartments; wherein,

each of the interfaces is configured to receive an ink refill unit for
replenishing the corresponding ink storage compartment.

A cradle with multiple refill interfaces allows each color of ink to be refilled simultaneously if necessary. It also allows the interface to be keyed to receive only the correctly colored refill. A single interface that docks with all refills, and relies on the user to direct the ink to a correct storage compartment, has increased risk of contaminating one color with another.

In some embodiments,the plurality of interfaces are formed adjacent each other in one panel of the cradle. Optionally, the panel is a lid that opens to allow the cartridge to be inserted
into the cradle, and closes such that the plurality of interfaces is
overlaid on the corresponding ink storage compartments. Optionally, each of the interfaces are keyed to only receive the ink refill that
is appropriate for the ink storage compartment corresponding to that
interface. Optionally,the lid has five interfaces, one for cyan, magenta, yellow, black and infra red inks respectively.

Optionally the plurality of interfaces are formed adjacent each other in one panel
of the cradle.

Optionally the panel is a lid that opens to allow the cartridge to be inserted
into the cradle, and closes such that the plurality of interfaces is
overlaid on the corresponding ink storage compartments.

Optionally each of the interfaces are keyed to only receive the ink refill that
is appropriate for the ink storage compartment corresponding to that
interface.

Optionally the lid has five interfaces, one for cyan, magenta, yellow, black and infra red inks respectively.

In a further aspect there is provided a cradle, wherein:
the cartridge has an ink feed system for connection to a printhead assembly with an array of ink ejection nozzles; and
the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a cradle, wherein:
the ink storage compartment is negatively pressurized and supplies ink to a printhead assembly;
the ink storage compartment has an interface for receiving the refill unit, the interface having an inlet valve biased to its closed configuration; and
the refill unit comprises:
a body containing a quantity of ink;
engagement formations for releasably engaging the interface; and
an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a cradle, wherein:
the ink storage compartment is negatively pressurized and supplies ink to a printhead assembly;
the cartridge comprises an interface for receiving the refill unit, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment;
the refill unit comprises a body containing a quantity of ink and a docking portion having an ink outlet and valve actuator formations; and
during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a cradle, wherein:
the ink storage compartment is negatively pressurized and supplies ink to a printhead assembly,
the refill unit refills the ink storage compartment via a normally open outlet valve and comprises:

a body containing a quantity of ink;
engagement formations for releasably engaging the ink storage compartment; and
an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a cradle, wherein:
the ink storage compartment supplies a printhead assembly with an array of nozzles, wherein during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;
the refill unit comprises a body containing a quantity of ink, an ink outlet, and a repressurizing arrangement;
upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a cradle, wherein:
the ink storage compartment has opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume;
the cartridge comprises an ink feed system for supplying for supplying ink to a printhead with an array of nozzles; and
one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a cradle, wherein:
the ink storage compartment has an interface for releasably engaging with the refill unit, the interface having valves for controlling ink flows into, and out of, the storage compartment; and
the refill unit comprises a body containing a quantity of ink, an ink outlet, and valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a cradle, wherein:
the cartridge that forms part of the inkjet printer;
the printer has a printhead, control circuitry and an interface for releasably engaging the refill unit;
the refill unit comprises a body containing a quantity of ink, an ink outlet, and a memory circuit for storing information relating to at least one characteristic of the ink; and
during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a cradle, further comprising a printhead maintenance assembly for an inkjet printhead, the printhead having a nozzle plate with an array of nozzles formed therein, the printhead maintenance assembly comprising:

a capper to cover the array of nozzles when the printhead is not in use; and,

a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided a cradle, wherein the inkjet printer comprises:

a printhead with an array of nozzles;

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a cradle, wherein:
the cartridge has an interface for engaging the ink refill unit; and
the ink refill unit comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and
engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

In a further aspect there is provided a cradle, wherein:

the cartridge has an interface for engaging the ink refill unit, an ink storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount; and

the ink refill unit comprises a body containing a quantity of ink and a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a cradle, wherein:

the cartridge has an interface for engaging the ink refill unit; and

the ink refill unit comprises:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and a spigot extending from the body for insertion in an aperture in the interface, the lateral cross section of the spigot being keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a cradle, wherein the ink refill unit comprises:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a cradle, wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided a cradle, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a cradle, wherein the inkjet printer comprises:

a replaceable pagewidth printhead with an array of nozzles and printhead contacts for transmitting power and print data to the nozzles;

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions, and

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a cradle, wherein the cartridge comprises:

an ink feed system for supplying ink from each ink compartment to a printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a cradle, wherein the printer has a printhead comprising:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

In a further aspect there is provided a cradle, wherein the inkjet printer has a printhead comprising:

a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;

a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and

a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits,
wherein polymer sealing film is more than 25 microns thick.

In a twentieth aspect the present invention provides a printhead for an inkjet printer, the printhead comprising:

a printhead integrated circuit formed on a wafer substrate using lithographically masked etching and deposition techniques;

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and,

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

To feed ink to the individual nozzles on the printhead integrated circuit (IC), it is often convenient to etch channels in the reverse side of the silicon wafer substrate. These channels need to be sealed and a polymer sealing film can provide an adequate seal as well as a means to secure the IC to a support structure. However, if the surface of the support structure is uneven, the seal provided by the polymer film can be compromised. The surface that the IC is secured to, is typically uneven because of more ink feed channels that deliver ink to the channels in the IC. As the film seals across the open channels in the support, it can also bulge or sag into them. The section of film that sags into a support structure channel runs across several of the etched channels in the printhead IC. The sagging may cause a gap between the walls separating each of the etched channels. Obviously, this breaches the seal and allows ink to leak out of the printhead IC and or between etched channels. To guard against this, the polymer sealing film should be thick enough to account for any sagging into the support structure channels while maintaining the seal over the etched channels in the IC.

The minimum thickness of the polymer sealing film will depend on a number of factors to be discussed in detail with reference to the preferred embodiments. However, the Applicant's analysis and testing has shown that a polymer sealing film thickness of 25 microns is adequate for the printhead IC's formed using lithographically masked etching and deposition techniques. Increasing the thickness to 50, 100 or even 200 microns will correspondingly increase the reliability of the seal provided.

In some embodiments, the polymer sealing film is more than 25 microns thick. Optionally, the polymer sealing film is more than 50 microns thick. Optionally, the polymer sealing film is more than 100 microns thick. Optionally, the polymer sealing film is about 200 microns thick.

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Optionally the polymer sealing film is more than 100 microns thick.
Optionally the polymer sealing film is about 200 microns thick.
In a further aspect there is provided a printhead incorporated in a cartridge unit for an inkjet printer, the cartridge unit comprising:

an ink storage compartment and an ink feed system for connection to the printhead, the printhead having an array of ink ejection nozzles,

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a printhead arranged to be supplied with ink by a negatively pressurized ink storage compartment, the ink storage compartment having an interface for receiving a refill unit for refilling the ink, the interface having an inlet valve biased to its closed configuration, wherein the refill unit comprises:

a body containing a quantity of ink;

engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a printhead incorporated in an ink cartridge having a negatively pressurized ink storage compartment that supplies ink to the printhead, and an interface for receiving a refill unit for refilling the ink, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment, wherein the refill unit comprises:

a body containing a quantity of ink; and

a docking portion having an ink outlet and valve actuator formations, and

wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a printhead arranged to be supplied with ink by a negatively pressurized ink storage compartment which is arranged to be refilled by a refill unit via a normally open outlet valve, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the ink storage compartment; and

an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a printhead arranged to be supplied with ink by an ink storage compartment which is arranged to be refilled by a refill unit, wherein:

the printhead has an array of nozzles;

during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;

the refill unit comprises a body containing a quantity of ink, an ink outlet and a repressurizing arrangement;

upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a printhead incorporated in an ink cartridge for an inkjet printer, the cartridge comprising:

an ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and

an ink feed system for supplying for supplying ink to the printhead which has an array of nozzles, wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a printhead arranged to be supplied with ink by an ink storage compartment having an interface for releasably engaging with a refill unit for refilling the ink, the

interface having valves for controlling ink flows into, and out of, the storage compartment, wherein the refill unit comprises:

a body containing a quantity of ink;

an ink outlet; and

valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a printhead incorporated in an ink cartridge that forms part of an inkjet printer, the printer having control circuitry and an interface for releasably engaging a refill unit for refilling the ink cartridge, wherein the refill unit comprises:

a body containing a quantity of ink;

an ink outlet; and

a memory circuit for storing information relating to at least one characteristic of the ink, and

wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a printhead, further comprising:

a nozzle plate with an array of nozzles formed therein; and

a printhead maintenance assembly comprising a capper to cover the array of nozzles when the printhead is not in use and a cleaner for engaging the nozzle plate and wiping across the nozzles, wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided a printhead, further comprising an array of nozzles, the printhead being incorporated in an inkjet printer comprising:

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a printhead incorporated in an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging an ink refill unit for replenishing the cartridge, wherein the ink refill unit comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

In a further aspect there is provided a printhead incorporated in an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging an ink refill for replenishing the cartridge, an ink storage compartment partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, wherein the ink refill unit comprises:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a printhead incorporated in an ink cartridge in an inkjet printer, the ink cartridge having an interface for engaging an ink refill unit for replenishing the cartridge, wherein the ink refill unit comprises:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, the lateral cross section of the spigot being keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a printhead incorporated in an ink cartridge in an inkjet printer, the ink cartridge being arranged to be replenished by an ink refill unit, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a printhead incorporated in an inkjet printer comprising:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

the lid and the panel both open in the same direction.

In a further aspect there is provided a printhead arranged as a replaceable pagewidth printhead of an inkjet printer and to have an array of nozzles and printhead contacts for transmitting power and print data to the nozzles, wherein the printer comprises:

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a printhead arranged as a replaceable pagewidth printhead of an inkjet printer and to have an array of nozzles and printhead contacts for transmitting power and print data to the nozzles, wherein the printer comprises:

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions, and

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a printhead incorporated in a cartridge for an inkjet printer, the cartridge comprising:

at least one ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to the printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a printhead incorporated in a cradle for holding an ink cartridge within an inkjet printer, the cartridge having a plurality of ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments,

wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a printhead for an inkjet printer, wherein the printhead integrated circuit has an array of ink ejection nozzles formed on a substrate, the printhead further comprising:
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits, polymer sealing film being more than 25 microns thick.

In a twenty first aspect the present invention provides a printhead for an inkjet printer, the printhead comprising:

a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;

a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and,

a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits; wherein,

the polymer sealing film is more than 25 microns thick.

To feed ink to the individual nozzles on the printhead integrated circuit (IC), it is often convenient to etch channels in the reverse side of the silicon wafer substrate. These channels need to be sealed and a polymer sealing film can provide an adequate seal as well as a means to secure the IC to a support structure. However, if the surface of the support structure is uneven, the seal provided by the polymer film can be compromised. The surface that the IC is secured to, is typically uneven because of more ink feed channels that deliver ink to the channels in the IC. As the film seals across the open channels in the support, it can also bulge or sag into them. The section of film that sags into a support structure channel runs across several of the etched channels in the printhead IC. The sagging may cause a gap between the walls separating each of the etched channels. Obviously, this breaches the seal and allows ink to leak out of the printhead IC and or between etched channels. To guard against this, the polymer sealing film should be thick enough to account for any sagging into the support structure channels while maintaining the seal over the etched channels in the IC.

The minimum thickness of the polymer sealing film will depend on a number of factors to be discussed in detail with reference to the preferred embodiments. However, the Applicant's analysis

and testing has shown that a polymer sealing film thickness of 25 microns is adequate for the printhead IC's formed using lithographically masked etching and deposition techniques. Increasing the thickness to 50, 100 or even 200 microns will correspondingly increase the reliability of the seal provided.

In some embodiments the array of apertures is an array of laser drilled holes in registration with respective ends of the ink feed conduits. Optionally, the polymer sealing film is a laminate with an adhesive layer on both sides of a thermoplastic film. Optionally, the thermoplastic film is a PET or polysulphone. Optionally, the polymer sealing film is more than 150 microns thick. Optionally, the ink feed conduits are formed in a liquid crystal polymer micro molding.

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Optionally the ink feed conduits are formed in a liquid crystal polymer micro molding.

In a further aspect there is provided a printhead incorporated in a cartridge unit for the inkjet printer, the cartridge unit comprising the ink storage compartment and an ink feed system for connection to the printhead,

wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

In a further aspect there is provided a printhead arranged to be supplied with ink by a negatively pressurized ink storage compartment, the ink storage compartment having an interface for receiving a refill unit for refilling the ink, the interface having an inlet valve biased to its closed configuration, wherein the refill unit comprises:

a body containing a quantity of ink;

engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

In a further aspect there is provided a printhead incorporated in an ink cartridge having a negatively pressurized ink storage compartment that supplies ink to the printhead, and an interface for receiving a refill unit for refilling the ink, the interface having a normally closed inlet valve and a normally

open outlet valve, both in fluid communication with the ink storage compartment, wherein the refill unit comprises:
a body containing a quantity of ink; and
a docking portion having an ink outlet and valve actuator formations, and
wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

In a further aspect there is provided a printhead arranged to be supplied with ink by a negatively pressurized ink storage compartment which is arranged to be refilled by a refill unit via a normally open outlet valve, the refill unit comprising:
a body containing a quantity of ink;
engagement formations for releasably engaging the ink storage compartment; and
an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

In a further aspect there is provided a printhead, wherein:
the ink storage compartment is arranged to be refilled by a refill unit;
during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;
the refill unit comprises a body containing a quantity of ink, an ink outlet and a repressurizing arrangement;
upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and
upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

In a further aspect there is provided a printhead incorporated in an ink cartridge for the inkjet printer, the cartridge comprising:
the ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and
an ink feed system for supplying for supplying ink to the printhead which has an array of nozzles,

wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

In a further aspect there is provided a printhead, wherein:
the ink storage compartment has an interface for releasably engaging with a refill unit for refilling the ink, the interface having valves for controlling ink flows into, and out of, the storage compartment; and
the refill unit comprises a body containing a quantity of ink, an ink outlet and valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

In a further aspect there is provided a printhead incorporated in an ink cartridge that forms part of the inkjet printer, the printer having control circuitry and an interface for releasably engaging a refill unit for refilling the ink cartridge, wherein the refill unit comprises:
a body containing a quantity of ink;
an ink outlet; and
a memory circuit for storing information relating to at least one characteristic of the ink, and
wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

In a further aspect there is provided a printhead, further comprising:
a nozzle plate with the array of nozzles formed therein; and
a printhead maintenance assembly comprising a capper to cover the array of nozzles when the printhead is not in use and a cleaner for engaging the nozzle plate and wiping across the nozzles, wherein the cleaner is positioned between opposing sides of the capper.

In a further aspect there is provided a printhead, wherein the inkjet printer comprises:

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

In a further aspect there is provided a printhead incorporated in an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging an ink refill unit for replenishing the cartridge, wherein the ink refill unit comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

In a further aspect there is provided a printhead incorporated in an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging an ink refill for replenishing the cartridge, the ink storage compartment which is partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, wherein the ink refill unit comprises:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

In a further aspect there is provided a printhead incorporated in an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging an ink refill unit for replenishing the cartridge, wherein the ink refill unit comprises:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, the lateral cross section of the spigot being keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

In a further aspect there is provided a printhead incorporated in an ink cartridge in the inkjet printer, the ink cartridge being arranged to be replenished by an ink refill unit, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

In a further aspect there is provided a printhead, wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

wherein the lid and the panel both open in the same direction.

In a further aspect there is provided a printhead arranged as a replaceable pagewidth printhead of the inkjet printer and to have printhead contacts for transmitting power and print data to the nozzles, wherein the printer comprises:

corresponding contacts for supplying the power and print data to the printhead contacts; and

a selective biasing mechanism, such that the printhead contacts and the corresponding contacts are biased into engagement during printing and released from biased engagement when installing or removing the printhead.

In a further aspect there is provided a printhead arranged as a replaceable pagewidth printhead of the inkjet printer and to have printhead contacts for transmitting power and print data to the nozzles, wherein the printer comprises:

corresponding contacts for supplying the power and print data to the printhead contacts; and

a cover member for movement between open and closed positions, and

wherein in the open positions, the printhead can be installed or removed, and the cover member is in the closed positions during printing, such that the printhead contacts and the corresponding contacts are moved into engagement when the cover member is moved to the closed positions, and the printhead contacts and the corresponding contacts disengage when the cover member is moved to the open positions.

In a further aspect there is provided a printhead incorporated in a cartridge for the inkjet printer, the cartridge comprising:

at least one of ink storage compartment;

an ink feed system for supplying ink from the or each ink compartment to the printhead; and

a maintenance station for engaging the printhead to perform one or more maintenance functions.

In a further aspect there is provided a printhead incorporated in a cradle for holding an ink cartridge within the inkjet printer, the cartridge having a plurality of the ink storage compartments, the cradle comprising a plurality of interfaces respectively corresponding to the ink storage compartments, wherein each of the interfaces is configured to receive an ink refill unit for replenishing the corresponding ink storage compartment.

In a further aspect there is provided a printhead, wherein the printhead integrated circuit is formed on a wafer substrate using lithographically masked etching and deposition techniques, the printhead further comprising:

an integrated circuit support structure for mounting in the printer adjacent a media feed path; and

a polymer sealing film between the integrated circuit support structure and the printhead integrated circuit for fixing the printhead integrated circuit to the integrated circuit support structure.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described by way of example only, with reference to the preferred embodiments shown in the accompanying figures, in which:

Fig. 1 shows a front perspective view of a printer with paper in the input tray and the collection tray extended;

Fig. 2 shows the printer unit of Fig. 1 (without paper in the input tray and with the collection tray retracted) with the casing open to expose the interior;

Fig. 3 shows a schematic of document data flow in a printing system according to one embodiment of the present invention;

Fig. 4 shows a more detailed schematic showing an architecture used in the printing system of Fig. 3;

Fig. 5 shows a block diagram of an embodiment of the control electronics as used in the printing system of Fig. 3;

Fig. 6 shows a perspective view of a cradle unit with open cover assembly and cartridge unit removed therefrom;

Fig. 7 shows the cradle unit of Fig. 6 with the cover assembly in its closed position;

Fig. 8 shows a front perspective view of the cartridge unit of Fig. 6;

Fig. 9 shows an exploded perspective view of the cartridge unit of Fig. 8;

Fig. 10 shows an exploded front perspective view of the main body of the cartridge unit shown in Fig. 9;

Fig. 11 shows a bottom perspective view of the ink storage module assembly that locates in the main body shown in Fig. 9;

Fig. 12 shows an exploded perspective view of one of the ink storage modules shown in Fig 11;

Fig. 13 shows a bottom perspective view of an ink storage module shown in Fig. 12;

Fig. 14 shows a top perspective view of an ink storage module shown in Fig. 12;

Fig. 15 shows a top perspective view of the printhead assembly shown in Fig. 9;

Fig. 16 shows an exploded view of the printhead assembly shown in Fig. 15;

Fig. 17 shows an inverted exploded view of the printhead assembly shown in Fig. 15;

Fig. 18 shows a cross-sectional end view of the printhead assembly of Fig. 15;

Fig. 19 shows a magnified partial perspective view of the drop triangle end of a printhead integrated circuit module as shown in Figs. 16 to 18;

Fig. 20 shows a magnified perspective view of the join between two printhead integrated circuit modules shown in Figs. 16 to 19;

Fig. 21 shows an underside view of the printhead integrated circuit shown in Fig. 19;

Fig. 22A shows a transparent top view of a printhead assembly of Fig.15 showing in particular, the ink conduits for supplying ink to the printhead integrated circuits;

Fig. 22B is a partial enlargement of Fig. 22A;

Fig. 23 shows a vertical sectional view of a single nozzle for ejecting ink, for use with the invention, in a quiescent state;

Fig. 24 shows a vertical sectional view of the nozzle of Fig. 23 during an initial actuation phase;

Fig. 25 shows a vertical sectional view of the nozzle of Fig. 24 later in the actuation phase;

Fig. 26 shows a perspective partial vertical sectional view of the nozzle of Fig. 23, at the actuation state shown in Fig. 25;

Fig. 27 shows a perspective vertical section of the nozzle of Fig. 23, with ink omitted;

Fig. 28 shows a vertical sectional view of the of the nozzle of Fig. 27;

Fig. 29 shows a perspective partial vertical sectional view of the nozzle of Fig. 23, at the actuation state shown in Fig. 24;

Fig. 30 shows a plan view of the nozzle of Figure 23;

Fig. 31 shows a plan view of the nozzle of Figure 23 with the lever arm and movable nozzle removed for clarity;

Fig. 32 shows a perspective vertical sectional view of a part of a printhead chip incorporating a plurality of the nozzle arrangements of the type shown in Fig. 23;

Fig. 33 shows a schematic cross-sectional view through an ink chamber of a single nozzle for injecting ink of a bubble forming heater element actuator type.

Figs. 34A to 34C show the basic operational principles of a thermal bend actuator;

Fig. 35 shows a three dimensional view of a single ink jet nozzle arrangement constructed in accordance with Fig. 34;

Fig. 36 shows an array of the nozzle arrangements shown in Figure 35;

Fig. 37 shows a schematic showing CMOS drive and control blocks for use with the printer of the present invention;

Fig. 38 shows a schematic showing the relationship between nozzle columns and dot shift registers in the CMOS blocks of Fig. 37;

Fig. 39 shows a more detailed schematic showing a unit cell and its relationship to the nozzle columns and dot shift registers of Fig. 38;

Fig. 40 shows a circuit diagram showing logic for a single printer nozzle in the printer of the present invention;

Fig. 41 shows a front perspective view of the maintenance assembly of the cartridge unit shown in Fig. 9;

Fig. 42 shows an exploded front perspective view of the maintenance assembly of Fig. 41;

Fig. 43 shows an exploded front perspective view of the underside of the maintenance assembly of Fig. 41;

Fig 44 shows a sectional view of the maintenance assembly operationally mounted to the cartridge unit of the present invention in a capped state;

Fig 45A and 45B show front and rear perspective views of the frame structure of the cradle unit according to one embodiment of the present invention;

Figs. 46A – 46B show left and right perspective views of the maintenance drive assembly of the present invention remote from the frame structure of Figs. 45A and 45B;

Fig. 47 shows a perspective view of the support bar assembly of Figs. 45A and 45B assembled to the PCB assembly;

Fig. 48 shows a perspective side view of the arms of the support bar assembly of Fig. 47 connected to a spring element associated with the cover assembly;

Figs. 49A – 49C show various views of the cradle unit according to one embodiment of the present invention;

Figs. 50A and 50B show sectional side views of the cradle unit with the cover assembly in a closed and open position respectively;

Figs. 51A and 51B show top and bottom perspective views of the ink refill unit according to one embodiment of the present invention;

Fig. 51C shows an exploded view of the ink refill unit of Figs. 51A and 51B;

Fig. 52 shows a perspective view of the ink refill unit of Figs. 51A and 51B docked with the docking ports of the cover assembly;

Fig. 53 shows a plan view of the cradle with the cartridge inside and the cover closed;

Fig. 54A shows a cross-sectional view of the ink refill unit and the print engine along line A-A of Fig. 53;

Fig. 54B shows a cross-sectional view of the ink refill unit and the print engine along line B-B of Fig. 53;

Fig. 54C shows a cross-sectional view of the ink refill unit in docking position with the print engine along line C-C of Fig. 53; and

Fig. 54D a cross-sectional view of the ink refill unit in docking position with the print engine along line D-D of Fig. 53.

DETAILED DESCRIPTION OF EMBODIMENTS

Fig. 1 shows a printer unit 2 embodying the present invention. Media supply tray 3 supports and supplies media 8 to be printed by the print engine (concealed within the printer casing). Printed sheets of media 8 are fed from the print engine to a media output tray 4 for collection. User interface 5 is an LCD touch screen and enables a user to control the operation of the printer unit 2.

Fig. 2 shows the lid 7 of the printer unit 2 open to expose the print engine 1 positioned in the internal cavity 6. Picker mechanism 9 engages the media in the input tray 3 (not shown for clarity) and feeds individual streets to the print engine 1. The print engine 1 includes media transport means that takes the individual sheets and feeds them past a printhead assembly (described below) for printing and subsequent delivery to the media output tray 4 (shown retracted).

Fig. 3 schematically shows how the printer unit 2 is arranged to print documents received from an external source, such as a computer system 702, onto a print media, such as a sheet of paper. In this regard, the printer unit 2 includes an electrical connection with the computer system 702 to receive pre-processed data. In the particular situation shown, the external computer system 702 is programmed to perform various steps involved in printing a document, including receiving the document (step 703), buffering it (step 704) and rasterizing it (step 706), and then compressing it (step 708) for transmission to the printer unit 2.

The printer unit 2 according to one embodiment of the present invention, receives the document from the external computer system 702 in the form of a compressed, multi-layer page image, wherein control electronics 766 buffers the image (step 710), and then expands the image (step 712) for further processing. The expanded contone layer is dithered (step 714) and then the black layer from the expansion step is composited over the dithered contone layer (step 716). Coded data may also be rendered (step 718) to form an additional layer, to be printed (if desired) using an infrared ink that is substantially invisible to the human eye. The black, dithered contone and infrared layers are combined (step 720) to form a page that is supplied to a printhead for printing (step 722).

In this particular arrangement, the data associated with the document to be printed is divided into a high-resolution bi-level mask layer for text and line art and a medium-resolution contone color image layer for images or background colors. Optionally, colored text can be supported by the addition of a medium-to-high-resolution contone texture layer for texturing text and line art with color data taken from an image or from flat colors. The printing architecture generalises these contone layers by representing them in abstract "image" and "texture" layers which can refer to either image data or flat color data. This division of data into layers based on content follows the base mode Mixed Raster Content (MRC) mode as would be understood by a person skilled in the art. Like the MRC base mode, the printing architecture makes compromises in some cases when data to be printed overlap. In particular, in one form all overlaps are reduced to a 3-layer representation in a process (collision resolution) embodying the compromises explicitly.

Fig. 4 sets out the print data processing by the print engine controller 766. As mentioned previously, data is delivered to the printer unit 2 in the form of a compressed, multi-layer page image with the pre-processing of the image performed by a mainly software-based computer system 702. In turn, the print engine controller 766 processes this data using a mainly hardware-based system.

Upon receiving the data, a distributor 730 converts the data from a proprietary representation into a hardware-specific representation and ensures that the data is sent to the correct hardware device whilst observing any constraints or requirements on data transmission to these devices. The distributor 730 distributes the converted data to an appropriate one of a plurality of pipelines 732. The pipelines are identical to each other, and in essence provide decompression, scaling and dot compositing functions to generate a set of printable dot outputs.

Each pipeline 732 includes a buffer 734 for receiving the data. A contone decompressor 736 decompresses the color contone planes, and a mask decompressor decompresses the monotone (text) layer. Contone and mask scalers 740 and 742 scale the decompressed contone and mask planes respectively, to take into account the size of the medium onto which the page is to be printed.

The scaled contone planes are then dithered by ditherer 744. In one form, a stochastic dispersed-dot dither is used. Unlike a clustered-dot (or amplitude-modulated) dither, a dispersed-dot (or frequency-modulated) dither reproduces high spatial frequencies (i.e. image detail) almost to the limits of the dot resolution, while simultaneously reproducing lower spatial frequencies to their full color depth, when spatially integrated by the eye. A stochastic dither matrix is carefully designed to be relatively free of objectionable low-frequency patterns when tiled across the image. As such, its size typically exceeds the minimum size required to support a particular number of intensity levels (e.g. 16 x 16 x 8 bits for 257 intensity levels).

The dithered planes are then composited in a dot compositor 746 on a dot-by-dot basis to provide dot data suitable for printing. This data is forwarded to data distribution and drive electronics 748, which in turn distributes the data to the correct nozzle actuators 750, which in turn cause ink to be ejected from the correct nozzles 752 at the correct time in a manner which will be described in more detail later in the description.

As will be appreciated, the components employed within the print engine controller 766 to process the image for printing depend greatly upon the manner in which data is presented. In this regard it may be possible for the print engine controller 766 to employ additional software and/or hardware components to perform more processing within the printer unit 2 thus reducing the reliance upon the computer system 702. Alternatively, the print engine controller 766 may employ fewer software and/or hardware components to perform less processing thus relying upon the computer system 702 to process the image to a higher degree before transmitting the data to the printer unit 2.

Fig. 5 provides a block representation of the components necessary to perform the above mentioned tasks. In this arrangement, the hardware pipelines 732 are embodied in a Small Office Home Office Printer Engine Chip (SoPEC) 766. As shown, a SoPEC device consists of 3 distinct subsystems: a Central Processing Unit (CPU) subsystem 771, a Dynamic Random Access Memory (DRAM) subsystem 772 and a Print Engine Pipeline (PEP) subsystem 773.

The CPU subsystem 771 includes a CPU 775 that controls and configures all aspects of the other subsystems. It provides general support for interfacing and synchronizing all elements of the print engine 1. It also controls the low-speed communication to QA chips (described below). The CPU subsystem 771 also contains various peripherals to aid the CPU 775, such as General Purpose Input Output (GPIO, which includes motor control), an Interrupt Controller Unit (ICU), LSS Master and general timers. The Serial Communications Block (SCB) on the CPU subsystem provides a full speed USB1.1 interface to the host as well as an Inter SoPEC Interface (ISI) to other SoPEC devices (not shown).

The DRAM subsystem 772 accepts requests from the CPU, Serial Communications Block (SCB) and blocks within the PEP subsystem. The DRAM subsystem 772, and in particular the DRAM Interface Unit (DIU), arbitrates the various requests and determines which request should win access to the DRAM. The DIU arbitrates based on configured parameters, to allow sufficient access to DRAM for all requestors. The DIU also hides the implementation specifics of the DRAM such as page size, number of banks and refresh rates.

The Print Engine Pipeline (PEP) subsystem 773 accepts compressed pages from DRAM and renders them to bi-level dots for a given print line destined for a printhead interface (PHI) that communicates directly with the printhead. The first stage of the page expansion pipeline is the Contone Decoder Unit (CDU), Lossless Bi-level Decoder (LBD) and, where required, Tag Encoder (TE). The CDU expands the JPEG-compressed contone (typically CMYK) layers, the LBD expands the compressed bi-level layer (typically K), and the TE encodes any Netpage tags for later rendering (typically in IR or K ink), in the event that the printer unit 2 has Netpage capabilities (see the cross referenced documents for a detailed explanation of the Netpage system). The output from the first stage is a set of buffers: the Contone FIFO unit (CFU), the Spot FIFO Unit (SFU), and the Tag FIFO Unit (TFU). The CFU and SFU buffers are implemented in DRAM.

The second stage is the Halftone Compositor Unit (HCU), which dithers the contone layer and composites position tags and the bi-level spot layer over the resulting bi-level dithered layer.

A number of compositing options can be implemented, depending upon the printhead with which the SoPEC device is used. Up to 6 channels of bi-level data are produced from this stage, although not all channels may be present on the printhead. For example, the printhead may be CMY only, with K pushed into the CMY channels and IR ignored. Alternatively, any encoded tags may be printed in K if IR ink is not available (or for testing purposes).

In the third stage, a Dead Nozzle Compensator (DNC) compensates for dead nozzles in the printhead by color redundancy and error diffusing of dead nozzle data into surrounding dots.

The resultant bi-level 5 channel dot-data (typically CMYK, Infrared) is buffered and written to a set of line buffers stored in DRAM via a Dotline Writer Unit (DWU).

Finally, the dot-data is loaded back from DRAM, and passed to the printhead interface via a dot FIFO. The dot FIFO accepts data from a Line Loader Unit (LLU) at the system clock rate (*pclk*), while the PrintHead Interface (PHI) removes data from the FIFO and sends it to the printhead at a rate of 2/3 times the system clock rate.

In the preferred form, the DRAM is 2.5Mbytes in size, of which about 2Mbytes are available for compressed page store data. A compressed page is received in two or more bands, with a number

of bands stored in memory. As a band of the page is consumed by the PEP subsystem 773 for printing, a new band can be downloaded. The new band may be for the current page or the next page.

Using banding it is possible to begin printing a page before the complete compressed page is downloaded, but care must be taken to ensure that data is always available for printing or a buffer under-run may occur.

The embedded USB 1.1 device accepts compressed page data and control commands from the host PC, and facilitates the data transfer to either the DRAM (or to another SoPEC device in multi-SoPEC systems, as described below).

Multiple SoPEC devices can be used in alternative embodiments, and can perform different functions depending upon the particular implementation. For example, in some cases a SoPEC device can be used simply for its onboard DRAM, while another SoPEC device attends to the various decompression and formatting functions described above. This can reduce the chance of buffer under-run, which can happen in the event that the printer commences printing a page prior to all the data for that page being received and the rest of the data is not received in time. Adding an extra SoPEC device for its memory buffering capabilities doubles the amount of data that can be buffered, even if none of the other capabilities of the additional chip are utilized.

Each SoPEC system can have several quality assurance (QA) devices designed to cooperate with each other to ensure the quality of the printer mechanics, the quality of the ink supply so the printhead nozzles will not be damaged during prints, and the quality of the software to ensure printheads and mechanics are not damaged.

Normally, each printing SoPEC will have an associated printer unit QA, which stores information relating to the printer unit attributes such as maximum print speed. The cartridge unit may also contain a QA chip, which stores cartridge information such as the amount of ink remaining, and may also be configured to act as a ROM (effectively as an EEPROM) that stores printhead-specific information such as dead nozzle mapping and printhead characteristics. The refill unit may also contain a QA chip, which stores refill ink information such as the type/colour of the ink and the amount of ink present for refilling. The CPU in the SoPEC device can optionally load and run program code from a QA Chip that effectively acts as a serial EEPROM. Finally, the CPU in the SoPEC device runs a logical QA chip (i.e., a software QA chip).

Usually, all QA chips in the system are physically identical, with only the contents of flash memory differentiating one from the other.

Each SoPEC device has two LSS system buses that can communicate with QA devices for system authentication and ink usage accounting. A large number of QA devices can be used per bus

and their position in the system is unrestricted with the exception that printer QA and ink QA devices should be on separate LSS busses.

In use, the logical QA communicates with the ink QA to determine remaining ink. The reply from the ink QA is authenticated with reference to the printer QA. The verification from the printer QA is itself authenticated by the logical QA, thereby indirectly adding an additional authentication level to the reply from the ink QA.

Data passed between the QA chips is authenticated by way of digital signatures. In the preferred embodiment, HMAC-SHA1 authentication is used for data, and RSA is used for program code, although other schemes could be used instead.

As will be appreciated, the SoPEC device therefore controls the overall operation of the print engine 1 and performs essential data processing tasks as well as synchronising and controlling the operation of the individual components of the print engine 1 to facilitate print media handling, as will be discussed below.

Print Engine

The print engine 1 is shown in detail in Figs. 6 and 7 and consists of two main parts: a cartridge unit 10 and a cradle unit 12.

The cartridge unit 10 is shaped and sized to be received within the cradle unit 12 and secured in position by a cover assembly 11 mounted to the cradle unit. The cradle unit 12 is in turn configured to be fixed within the printer unit 2 to facilitate printing as discussed above.

Fig. 7 shows the print engine 1 in its assembled form with cartridge unit 10 secured in the cradle unit 12 and cover assembly 11 closed. The print engine 1 controls various aspects associated with printing in response to user inputs from the user interface 5 of the printer unit 2. These aspects include transporting the media past the printhead in a controlled manner and the controlled ejection of ink onto the surface of the passing media.

Cartridge unit

The cartridge unit 10 is shown in detail in Figs. 8 and 9. With reference to the exploded view of Fig. 9, the cartridge unit 10 generally consists of a main body 20, an ink storage module assembly 21, a printhead assembly 22 and a maintenance assembly 23.

Each of these parts are assembled together to form an integral unit which combines ink storage means together with the ink ejection means. Such an arrangement ensures that the ink is directly supplied to the printhead assembly 22 for printing, as required, and should there be a need to

replace either or both of the ink storage or the printhead assembly, this can be readily done by replacing the entire cartridge unit 10.

However, the operating life of the printhead is not limited by the supply of ink. The top surface 42 of the cartridge unit 10 has interfaces 61 for docking with a refill supply of ink to replenish the ink storage modules 45 when necessary. The ink refill unit and the process of docking with the cartridge are discussed in greater detail below. To further extend the life of the printhead, the cartridge unit carries an integral printhead maintenance assembly 23 that caps, wipes and moistens the printhead. This assembly is also described in more detail later.

Main Body

The main body 20 of the cartridge unit 10 is shown in more detail in Fig. 10 and comprises a substantially rectangular frame 25 having an open top and an open longitudinally extending side wall. A pair of posts 26 project from the underside of the frame at either end. These posts 26 are provided to mount the maintenance assembly 23 to the main body 10, in a manner described below.

An ink outlet molding 27 has ink outlets (not shown) in its underside corresponding to each of the ink storage modules 45 to be housed in the main body 20. Each of the ink outlets has a pair of inwardly extending silicone rings seals. The rings seals are co-molded with the ink outlet molding 27 and seal against the ink inlets to the printhead assembly described below. The ink outlet molding 27 is ultra sonically welded to the underside of the rectangular frame 25.

Along one longitudinal wall of the frame 25 are a series of ink downpipes 30. Each downpipe 30 has an O-ring seal 29 at its upper end to form a sealed connection with the ink outlet of respective ink storage modules (described below). When the ink outlet molding 27 is welded to the body 20, each ink downpipe 30 is in fluid communication with respective ink outlets in the underside of the molding 27.

The air sleeve 31 is connected to a pressurized air source (not shown) and provides an air flow into the printhead assembly where it is directed across the printhead nozzles to avoid paper dust clogging (discussed further below).

Ink filing ports 35 are formed in the lower parts of each ink downpipe 30. These filling ports are for the initial charging of the ink storage assemblies 21 only. Any subsequent refilling of the ink storages assemblies, uses the ink refill units described below. To assist the initial filling process, a vacuum is applied to the air vents 41 in the top surface 42 of the cartridge unit 10 (see Fig. 9). The air vents 41 are connected to the interior of the ink bag in each ink storage module 45 (described below). Ink is fed through the filling port 35 and drawn up the ink downpipe 30 into the ink storage volume. During the filling process, the cartridge unit is tilted so that the air vents 41 are the highest

point in each of the respective ink bag, and filled until the vacuum draws ink through the air vent 41. This ensures that each ink bag is completely filled and purged of air. Skilled workers in this field will appreciate that air bubbles entrained with the ink flow to the printhead can harm the operation of the nozzles.

As shown in Figs. 15 to 17, the lower member 65 is provided with a plurality of priming inlets 85 at one end thereof. Each of the priming inlets 85 communicate directly with one of the channels 67 and provide an alternative, or additional means for priming the ink storage modules 45 with ink prior to shipment and use.

When the ink storage modules are full, a polymer sealing ball 33 is inserted into the filling port 35 and the air vent 41.

A metal plate 34 mounts to the underside of the frame 25 and the outlet molding 30 to provide the cartridge unit 10 with structural rigidity. It is snap locked into place by hooking the detents 38 into slots (not shown) in the back wall of the frame 25 and rotating the plate 34 until the line of barbed snap lock formations 32 clip into the outer line of apertures 37.

The plate 34 has holes 39 to receive the ink outlets (not shown) that project from the lower surface of the outlet molding 27. The pressed metal plate 34 also has a flange portion 40 projecting downwardly with respect to the frame 25, which acts as a load bearing surface discussed in more detail below.

The ink storage assembly lid 21 of the cartridge unit 10 is shown in detail in Figs. 11 to 14. The lid 21 is configured to mate with the frame 25 of the main body 20 to form an enclosed unit. As best shown in Fig. 11, the ink storage modules 45 are mounted to the underside of the lid 21 and extend into the individual cavities 36 provided by the main body 20 (see Fig.10).

One of the ink storage modules 45 is shown in isolation in Fig. 12, 13 and 14. Ink bag 46 is made from a flexible, air impermeable thermoplastic film such as Mylar® which allows ink to be retained therein in a pressurised state. The flexible bag 46 can expand as it is filled with ink and collapse as ink is consumed. This is discussed in more detail later with reference to the refilling process shown in Figs. 54A to 54 D.

The ink bag 46 extends between an upper plate member 47 and a lower plate member 48. It is heat welded (or similar) to the plates 47 and 48 for an air tight seal. The upper plate member 47 is arranged to receive a valve insert 49. The valve insert has an inlet valve 16 and an outlet valve 18. The valve insert 49 is positioned such that it can communicate directly with a port 51 formed in the top surface 42 to receive ink from an ink refill unit, as well as an outlet 52 to deliver ink to the printhead assembly 22. As best shown in Fig. 14, the inlet valve 15 receives the ink delivery needle of an ink refill unit (discussed later) through a slit positioned in the port 51 in the upper surface 42.

The inlet valve 16 is biased closed and opens when the refill unit (described below) docks with the cartridge unit 10.

Conversely, the outlet valve 18 is biased open and closes when the refill unit docks. A filter 215 covers the entrance to the outlet valve in the upper plate member 47. The filter is sized to remove solid contaminants and air bubbles. As discussed above, compressible air bubbles can prevent a nozzle from operating.

The outlet valve connects to a conduit 52 in the underside of the lid 21 which leads to the downpipe collar 216. When the ink storage assembly 21 is placed into the main body 20, the collar 216 seals over the O-ring seal 29 on the end of the downpipe 30.

The upper plate 47 is fixed to the underside of the lid 21 to hold the valve insert 49 in position. The lower plate 48 slides within the collar 57 and the inside edges of the four struts 19 extending from the underside of the lid 21. The plate 48 slides down the struts 19 as the bag 46 fills and expands. Conversely, it slides back towards the lid 21 as the bag 21 empties. The length of the bag 46 limits the travel of the lower plate 48 before it reaches the retaining bar 55. A constant force spring 54 extends between the retaining bar 55 and the recessed peg 53 to bias the plate 48 towards the retaining bar 55. In turn, this biases the bag 46 to expand and thereby maintains the ink within the bag at a negative pressure. This avoids ink leakage from the printhead nozzles.

Bag Constrictor.

Each ink storage module 45 has a bag constrictor 43 to re-establish the negative pressure in the ink after each refilling operation. The constrictor 43 has a lower collar 57 that abuts the ends of the struts 19 and is held in place by the retaining bar 55. The lower plate 48 slides upwardly within lower collar 57 as the ink bag 46 empties. Four bowed panels 58 extend upwardly from the lower collar 57 to an upper collar 59. The panels 58 bow slightly inwards. The ink refill unit (described below) has four constrictor actuators. When the refill docks with the cartridge unit, the constrictor actuators extend through the apertures 60 in the lid 21 to push the upper collar 59 towards the lower collar 57. This causes the panels 58 to bow further inwards to press on each side of the bag 46.

During refilling, the negative pressure in the ink bag 46 draws ink out of the refill unit. The negative pressure is created by the constant force spring 54 biasing the lower plate 48 to wards the retainer bar 55. When the ink bag is full, the negative pressure disappears. Without negative pressure in the ink bag 46, there is a risk of ink leakage from the nozzles. The negative pressure is re-established in the bag 46 when the refill unit is removed from the cartridge. As the four constrictor actuators retract through the apertures 60 in the lid 21, the bowed panels 58 can push the upper collar 59 back towards the upper plate member 47. The panels 58 straighten so that they are not pressing on

the sides of the bag 46 as much. This allows the bag 46 to bulge slightly, and as the inlet valve 16 is closed, the slight increase in bag volume restores the negative pressure.

PRINTHEAD ASSEMBLY

The printhead assembly 22 is shown in more detail in Figs. 15 to 18, and is adapted to be attached to the underside of the main body 20 to receive ink from the outlets molding 27 (see Fig. 10).

The printhead assembly 22 generally comprises an elongate upper member 62 which is configured to extends beneath the main body 20, between the posts 26. A plurality of U-shaped clips 63 project from the upper member 62. These pass through the recesses 37 provided in the rigid plate 34 and become captured by lugs (not shown) formed in the main body 20 to secure the printhead assembly 22.

The upper element 62 has a plurality of feed tubes 64 that are received within the outlets in the outlet molding 27 when the printhead assembly 22 secures to the main body 20. The feed tubes 64 may be provided with an outer coating to guard against ink leakage.

The upper member 62 is made from a liquid crystal polymer (LCP) which offers a number of advantages. It can be molded so that its coefficient of thermal expansion (CTE) is similar to that of silicon. It will be appreciated that any significant difference in the CTE's of the printhead integrated circuit 74 (discussed below) and the underlying moldings can cause the entire structure to bow. However, as the CTE of LCP in the mold direction is much less than that in the non- mold direction (~5ppm/°C compared to ~20ppm/°C), care must be take to ensure that the mold direction of the LCP moldings is unidirectional with the longitudinal extent of the printhead integrated circuit (IC) 74. LCP also has a relatively high stiffness with a modulus that is typically 5 times that of 'normal plastics' such as polycarbonates, styrene, nylon, PET and polypropylene.

As best shown in Fig. 16, upper member 62 has an open channel configuration for receiving a lower member 65, which is bonded thereto, via an adhesive film 66. The lower member 65 is also made from an LCP and has a plurality of ink channels 67 formed along its length. Each of the ink channels 67 receive ink from one of the feed tubes 64, and distribute the ink along the length of the printhead assembly 22. The channels are 1 mm wide and separated by 0.75 mm thick walls.

In the embodiment shown, the lower member 65 has five channels 67 extending along its length. Each channel 67 receives ink from only one of the five feed tubes 64, which in turn receives ink from one of the ink storage modules 45 (see Fig. 10) to reduce the risk of mixing different coloured inks. In this regard, adhesive film 66 also acts to seal the individual ink channels 67 to

prevent cross channel mixing of the ink when the lower member 65 is assembled to the upper member 62.

In the bottom of each channel 67 are a series of equi-spaced holes 69 (best seen in Fig. 17) to give five rows of holes 69 in the bottom surface of the lower member 65. The middle row of holes 69 extends along the centre-line of the lower member 65, directly above the printhead IC 74. As best seen in Fig. 22A, other rows of holes 69 on either side of the middle row need conduits 70 from each hole 69 to the centre so that ink can be fed to the printhead IC 74.

Referring to Fig. 18, the printhead IC 74 is mounted to the underside of the lower member 65 by a polymer sealing film 71. This film may be a thermoplastic film such as a PET or Polysulphone film, or it may be in the form of a thermoset film, such as those manufactured by AL technologies and Rogers Corporation. The polymer sealing film 71 is a laminate with adhesive layers on both sides of a central film, and laminated onto the underside of the lower member 65. As shown in Figs. 17, 22A and 22B, a plurality of holes 72 are laser drilled through the adhesive film 71 to coincide with the centrally disposed ink delivery points (the middle row of holes 69 and the ends of the conduits 70) for fluid communication between the printhead IC 74 and the channels 67.

The thickness of the polymer sealing film 71 is critical to the effectiveness of the ink seal it provides. As best seen in Figs. 21 to 22B, the polymer sealing film seals the etched channels 77 on the reverse side of the printhead IC 74, as well as the conduits 70 on the other side of the film. However, as the film 71 seals across the open end of the conduits 70, it can also bulge or sag into the conduit. The section of film that sags into a conduit 70 runs across several of the etched channels 77 in the printhead IC 74. The sagging may cause a gap between the walls separating each of the etched channels 77. Obviously, this breaches the seal and allows ink to leak out of the printhead IC 74 and or between etched channels 77.

To guard against this, the polymer sealing film 71 should be thick enough to account for any sagging into the conduits 70 while maintaining the seal over the etched channels 77. The minimum thickness of the polymer sealing film 71 will depend on:

1. the width of the conduit into which it sags;
2. the thickness of the adhesive layers in the film's laminate structure;
3. the 'stiffness' of the adhesive layer as the printhead IC 74 is being pushed into it; and,
4. the modulus of the central film material of the laminate.

A polymer sealing film 71 thickness of 25 microns is adequate for the printhead assembly 22 shown. However, increasing the thickness to 50, 100 or even 200 microns will correspondingly increase the reliability of the seal provided.

Ink delivery inlets 73 are formed in the 'front' surface of a printhead IC 74. The inlets 73 supply ink to respective nozzles 801 (described below with reference to Figs. 23 to 36) positioned on the inlets. The ink must be delivered to the IC's so as to supply ink to each and every individual inlet 73. Accordingly, the inlets 73 within an individual printhead IC 74 are physically grouped to reduce ink supply complexity and wiring complexity. They are also grouped logically to minimize power consumption and allow a variety of printing speeds.

Each printhead IC 74 is configured to receive and print five different colours of ink (C, M, Y, K and IR) and contains 1280 ink inlets per colour, with these nozzles being divided into even and odd nozzles (640 each). Even and odd nozzles for each colour are provided on different rows on the printhead IC 74 and are aligned vertically to perform true 1600 dpi printing, meaning that nozzles 801 are arranged in 10 rows, as clearly shown in Fig. 19. The horizontal distance between two adjacent nozzles 801 on a single row is 31.75 microns, whilst the vertical distance between rows of nozzles is based on the firing order of the nozzles, but rows are typically separated by an exact number of dot lines, plus a fraction of a dot line corresponding to the distance the paper will move between row firing times. Also, the spacing of even and odd rows of nozzles for a given colour must be such that they can share an ink channel, as will be described below.

As alluded to previously, the present invention is related to page-width printing and as such the printhead ICs 74 are arranged to extend horizontally across the width of the printhead assembly 22. To achieve this, individual printhead ICs 74 are linked together in abutting arrangement across the surface of the adhesive layer 71, as shown in Figs. 16 and 17. The printhead IC's 74 may be attached to the polymer sealing film 71 by heating the IC's above the melting point of the adhesive layer and then pressing them into the sealing film 71, or melting the adhesive layer under the IC with a laser before pressing them into the film. Another option is to both heat the IC (not above the adhesive melting point) and the adhesive layer, before pressing it into the film 71.

The length of an individual printhead IC 74 is around 20 – 22 mm. To print an A4/US letter sized page, 11 – 12 individual printhead ICs 74 are contiguously linked together. The number of individual printhead ICs 74 may be varied to accommodate sheets of other widths.

The printhead ICs 74 may be linked together in a variety of ways. One particular manner for linking the ICs 74 is shown in Fig. 20. In this arrangement, the ICs 74 are shaped at their ends to link together to form a horizontal line of ICs, with no vertical offset between neighboring ICs. A sloping join is provided between the ICs having substantially a 45° angle. The joining edge is not straight and has a sawtooth profile to facilitate positioning, and the ICs 74 are intended to be spaced about 11 microns apart, measured perpendicular to the joining edge. In this arrangement, the left most ink delivery nozzles 73 on each row are dropped by 10 line pitches and arranged in a triangle

configuration. This arrangement provides a degree of overlap of nozzles at the join and maintains the pitch of the nozzles to ensure that the drops of ink are delivered consistently along the printing zone. This arrangement also ensures that more silicon is provided at the edge of the IC 74 to ensure sufficient linkage. Whilst control of the operation of the nozzles is performed by the SoPEC device (discussed later in the description), compensation for the nozzles may be performed in the printhead, or may also be performed by the SoPEC device, depending on the storage requirements. In this regard it will be appreciated that the dropped triangle arrangement of nozzles disposed at one end of the IC 74 provides the minimum on-printhead storage requirements. However where storage requirements are less critical, shapes other than a triangle can be used, for example, the dropped rows may take the form of a trapezoid.

The upper surface of the printhead ICs have a number of bond pads 75 provided along an edge thereof which provide a means for receiving data and or power to control the operation of the nozzles 73 from the SoPEC device. To aid in positioning the ICs 74 correctly on the surface of the adhesive layer 71 and aligning the ICs 74 such that they correctly align with the holes 72 formed in the adhesive layer 71, fiducials 76 are also provided on the surface of the ICs 74. The fiducials 76 are in the form of markers that are readily identifiable by appropriate positioning equipment to indicate the true position of the IC 74 with respect to a neighbouring IC and the surface of the adhesive layer 71, and are strategically positioned at the edges of the ICs 74, and along the length of the adhesive layer 71.

In order to receive the ink from the holes 72 formed in the polymer sealing film 71 and to distribute the ink to the ink inlets 73, the underside of each printhead IC 74 is configured as shown in Fig 21. A number of etched channels 77 are provided, with each channel 77 in fluid communication with a pair of rows of inlets 73 dedicated to delivering one particular colour or type of ink. The channels 77 are about 80 microns wide, which is equivalent to the width of the holes 72 in the polymer sealing film 71, and extend the length of the IC 74. The channels 77 are divided into sections by silicon walls 78. Each sections is directly supplied with ink, to reduce the flow path to the inlets 73 and the likelihood of ink starvation to the individual nozzles 801. In this regard, each section feeds approximately 128 nozzles 801 via their respective inlets 73.

Fig. 22B shows more clearly how the ink is fed to the etched channels 77 formed in the underside of the ICs 74 for supply to the nozzles 73. As shown, holes 72 formed through the polymer sealing film 71 are aligned with one of the channels 77 at the point where the silicon wall 78 separates the channel 77 into sections. The holes 72 are about 80 microns in width which is substantially the same width of the channels 77 such that one hole 72 supplies ink to two sections of

the channel 77. It will be appreciated that this halves the density of holes 72 required in the polymer sealing film 71.

Following attachment and alignment of each of the printhead ICs 74 to the surface of the polymer sealing film 71, a flex PCB 79 (see Fig. 18) is attached along an edge of the ICs 74 so that control signals and power can be supplied to the bond pads 75 to control and operate the nozzles 801. As shown more clearly in Fig. 15, the flex PCB 79 extends from the printhead assembly 22 and folds around the printhead assembly 22.

The flex PCB 79 may also have a plurality of decoupling capacitors 81 arranged along its length for controlling the power and data signals received. As best shown in Fig. 16, the flex PCB 79 has a plurality of electrical contacts 180 formed along its length for receiving power and or data signals from the control circuitry of the cradle unit 12. A plurality of holes 80 are also formed along the distal edge of the flex PCB 79 which provide a means for attaching the flex PCB to the flange portion 40 of the rigid plate 34 of the main body 20. The manner in which the electrical contacts of the flex PCB 79 contact the power and data contacts of the cradle unit 12 will be described later.

As shown in Fig. 18, a media shield 82 protects the printhead ICs 74 from damage which may occur due to contact with the passing media. The media shield 82 is attached to the upper member 62 upstream of the printhead ICs 74 via an appropriate clip-lock arrangement or via an adhesive. When attached in this manner, the printhead ICs 74 sit below the surface of the media shield 82, out of the path of the passing media.

A space 83 is provided between the media shield 82 and the upper 62 and lower 65 members which can receive pressurized air from an air compressor or the like. As this space 83 extends along the length of the printhead assembly 22, compressed air can be supplied to the space 56 from either end of the printhead assembly 22 and be evenly distributed along the assembly. The inner surface of the media shield 82 is provided with a series of fins 84 which define a plurality of air outlets evenly distributed along the length of the media shield 82 through which the compressed air travels and is directed across the printhead ICs 74 in the direction of the media delivery. This arrangement acts to prevent dust and other particulate matter carried with the media from settling on the surface of the printhead ICs, which could cause blockage and damage to the nozzles.

INK DELIVERY NOZZLES

One example of a type of ink delivery nozzle arrangement suitable for the present invention, comprising a nozzle and corresponding actuator, will now be described with reference to Figures 23 to 32. Figure 32 shows an array of ink delivery nozzle arrangements 801 formed on a silicon substrate 8015. Each of the nozzle arrangements 801 are identical, however groups of nozzle

arrangements 801 are arranged to be fed with different colored inks or fixative. In this regard, the nozzle arrangements are arranged in rows and are staggered with respect to each other, allowing closer spacing of ink dots during printing than would be possible with a single row of nozzles. Such an arrangement makes it possible to provide a high density of nozzles, for example, more than 5000 nozzles arrayed in a plurality of staggered rows each having an interspacing of about 32 microns between the nozzles in each row and about 80 microns between the adjacent rows. The multiple rows also allow for redundancy (if desired), thereby allowing for a predetermined failure rate per nozzle.

Each nozzle arrangement 801 is the product of an integrated circuit fabrication technique. In particular, the nozzle arrangement 801 defines a micro-electromechanical system (MEMS).

For clarity and ease of description, the construction and operation of a single nozzle arrangement 801 will be described with reference to Figures 23 to 31.

The ink jet printhead integrated circuit 74 includes a silicon wafer substrate 8015 having 0.35 micron 1 P4M 12 volt CMOS microprocessing electronics is positioned thereon.

A silicon dioxide (or alternatively glass) layer 8017 is positioned on the substrate 8015. The silicon dioxide layer 8017 defines CMOS dielectric layers. CMOS top-level metal defines a pair of aligned aluminium electrode contact layers 8030 positioned on the silicon dioxide layer 8017. Both the silicon wafer substrate 8015 and the silicon dioxide layer 8017 are etched to define an ink inlet channel 8014 having a generally circular cross section (in plan). An aluminium diffusion barrier 8028 of CMOS metal 1, CMOS metal 2/3 and CMOS top level metal is positioned in the silicon dioxide layer 8017 about the ink inlet channel 8014. The diffusion barrier 8028 serves to inhibit the diffusion of hydroxyl ions through CMOS oxide layers of the drive electronics layer 8017.

A passivation layer in the form of a layer of silicon nitride 8031 is positioned over the aluminium contact layers 8030 and the silicon dioxide layer 8017. Each portion of the passivation layer 8031 positioned over the contact layers 8030 has an opening 8032 defined therein to provide access to the contacts 8030.

The nozzle arrangement 801 includes a nozzle chamber 8029 defined by an annular nozzle wall 8033, which terminates at an upper end in a nozzle roof 8034 and a radially inner nozzle rim 804 that is circular in plan. The ink inlet channel 8014 is in fluid communication with the nozzle chamber 8029. At a lower end of the nozzle wall, there is disposed a moving rim 8010, that includes a moving seal lip 8040. An encircling wall 8038 surrounds the movable nozzle, and includes a stationary seal lip 8039 that, when the nozzle is at rest as shown in Fig. 26, is adjacent the moving rim 8010. A fluidic seal 8011 is formed due to the surface tension of ink trapped between the stationary seal lip 8039 and the moving seal lip 8040. This prevents leakage of ink from the chamber whilst providing a low resistance coupling between the encircling wall 8038 and the nozzle wall 8033.

As best shown in Fig. 30, a plurality of radially extending recesses 8035 is defined in the roof 8034 about the nozzle rim 804. The recesses 8035 serve to contain radial ink flow as a result of ink escaping past the nozzle rim 804.

The nozzle wall 8033 forms part of a lever arrangement that is mounted to a carrier 8036 having a generally U-shaped profile with a base 8037 attached to the layer 8031 of silicon nitride.

The lever arrangement also includes a lever arm 8018 that extends from the nozzle walls and incorporates a lateral stiffening beam 8022. The lever arm 8018 is attached to a pair of passive beams 806, formed from titanium nitride (TiN) and positioned on either side of the nozzle arrangement, as best shown in Fig. 26 and 31. The other ends of the passive beams 806 are attached to the carrier 8036.

The lever arm 8018 is also attached to an actuator beam 807, which is formed from TiN. It will be noted that this attachment to the actuator beam is made at a point a small but critical distance higher than the attachments to the passive beam 806.

As best shown in Figs. 23 and 29, the actuator beam 807 is substantially U-shaped in plan, defining a current path between the electrode 809 and an opposite electrode 8041. Each of the electrodes 809 and 8041 are electrically connected to respective points in the contact layer 8030. As well as being electrically coupled via the contacts 809, the actuator beam is also mechanically anchored to anchor 808. The anchor 808 is configured to constrain motion of the actuator beam 807 to the left of Figs. 26 to 28 when the nozzle arrangement is in operation.

The TiN in the actuator beam 807 is conductive, but has a high enough electrical resistance that it undergoes self-heating when a current is passed between the electrodes 809 and 8041. No current flows through the passive beams 806, so they do not expand.

In use, the device at rest is filled with ink 8013 that defines a meniscus 803 under the influence of surface tension. The ink is retained in the chamber 8029 by the meniscus, and will not generally leak out in the absence of some other physical influence.

As shown in Fig. 24, to fire ink from the nozzle, a current is passed between the contacts 809 and 8041, passing through the actuator beam 807. The self-heating of the beam 807 due to its resistance causes the beam to expand. The dimensions and design of the actuator beam 807 mean that the majority of the expansion in a horizontal direction with respect to Figs. 23 to 25. The expansion is constrained to the left by the anchor 808, so the end of the actuator beam 807 adjacent the lever arm 8018 is impelled to the right.

The relative horizontal inflexibility of the passive beams 806 prevents them from allowing much horizontal movement the lever arm 8018. However, the relative displacement of the attachment points of the passive beams and actuator beam respectively to the lever arm causes a

twisting movement that causes the lever arm 8018 to move generally downwards. The movement is effectively a pivoting or hinging motion. However, the absence of a true pivot point means that the rotation is about a pivot region defined by bending of the passive beams 806.

The downward movement (and slight rotation) of the lever arm 8018 is amplified by the distance of the nozzle wall 8033 from the passive beams 806. The downward movement of the nozzle walls and roof causes a pressure increase within the chamber 8029, causing the meniscus to bulge as shown in Fig. 24. It will be noted that the surface tension of the ink means the fluid seal 8011 is stretched by this motion without allowing ink to leak out.

As shown in Fig. 25, at the appropriate time, the drive current is stopped and the actuator beam 807 quickly cools and contracts. The contraction causes the lever arm to commence its return to the quiescent position, which in turn causes a reduction in pressure in the chamber 8029. The interplay of the momentum of the bulging ink and its inherent surface tension, and the negative pressure caused by the upward movement of the nozzle chamber 8029 causes thinning, and ultimately snapping, of the bulging meniscus to define an ink drop 802 that continues upwards until it contacts adjacent print media.

Immediately after the drop 802 detaches, meniscus 803 forms the concave shape shown in Fig. 25. Surface tension causes the pressure in the chamber 8029 to remain relatively low until ink has been sucked upwards through the inlet 8014, which returns the nozzle arrangement and the ink to the quiescent situation shown in Fig. 23.

Another type of printhead nozzle arrangement suitable for the present invention will now be described with reference to Figure 33. Once again, for clarity and ease of description, the construction and operation of a single nozzle arrangement 1001 will be described.

The nozzle arrangement 1001 is of a bubble forming heater element actuator type which comprises a nozzle plate 1002 with a nozzle 1003 therein, the nozzle having a nozzle rim 1004, and aperture 1005 extending through the nozzle plate. The nozzle plate 1002 is plasma etched from a silicon nitride structure which is deposited, by way of chemical vapour deposition (CVD), over a sacrificial material which is subsequently etched.

The nozzle arrangement includes, with respect to each nozzle 1003, side walls 1006 on which the nozzle plate is supported, a chamber 1007 defined by the walls and the nozzle plate 1002, a multi-layer substrate 1008 and an inlet passage 1009 extending through the multi-layer substrate to the far side (not shown) of the substrate. A looped, elongate heater element 1010 is suspended within the chamber 1007, so that the element is in the form of a suspended beam. The nozzle arrangement as shown is a microelectromechanical system (MEMS) structure, which is formed by a lithographic process.

When the nozzle arrangement is in use, ink 1011 from a reservoir (not shown) enters the chamber 1007 via the inlet passage 1009, so that the chamber fills. Thereafter, the heater element 1010 is heated for somewhat less than 1 micro second, so that the heating is in the form of a thermal pulse. It will be appreciated that the heater element 1010 is in thermal contact with the ink 1011 in the chamber 1007 so that when the element is heated, this causes the generation of vapor bubbles in the ink. Accordingly, the ink 1011 constitutes a bubble forming liquid.

The bubble 1012, once generated, causes an increase in pressure within the chamber 1007, which in turn causes the ejection of a drop 1016 of the ink 1011 through the nozzle 1003. The rim 1004 assists in directing the drop 1016 as it is ejected, so as to minimize the chance of a drop misdirection.

The reason that there is only one nozzle 1003 and chamber 1007 per inlet passage 1009 is so that the pressure wave generated within the chamber, on heating of the element 1010 and forming of a bubble 1012, does not effect adjacent chambers and their corresponding nozzles.

The increase in pressure within the chamber 1007 not only pushes ink 1011 out through the nozzle 1003, but also pushes some ink back through the inlet passage 1009. However, the inlet passage 1009 is approximately 200 to 300 microns in length, and is only approximately 16 microns in diameter. Hence there is a substantial viscous drag. As a result, the predominant effect of the pressure rise in the chamber 1007 is to force ink out through the nozzle 1003 as an ejected drop 1016, rather than back through the inlet passage 1009.

As shown in Fig. 33, the ink drop 1016 is being ejected is shown during its “necking phase” before the drop breaks off. At this stage, the bubble 1012 has already reached its maximum size and has then begun to collapse towards the point of collapse 1017.

The collapsing of the bubble 1012 towards the point of collapse 1017 causes some ink 1011 to be drawn from within the nozzle 1003 (from the sides 1018 of the drop), and some to be drawn from the inlet passage 1009, towards the point of collapse. Most of the ink 1011 drawn in this manner is drawn from the nozzle 1003, forming an annular neck 1019 at the base of the drop 1016 prior to its breaking off.

The drop 1016 requires a certain amount of momentum to overcome surface tension forces, in order to break off. As ink 1011 is drawn from the nozzle 1003 by the collapse of the bubble 1012, the diameter of the neck 1019 reduces thereby reducing the amount of total surface tension holding the drop, so that the momentum of the drop as it is ejected out of the nozzle is sufficient to allow the drop to break off.

When the drop 1016 breaks off, cavitation forces are caused as reflected by the arrows 1020, as the bubble 1012 collapses to the point of collapse 1017. It will be noted that there are no solid surfaces in the vicinity of the point of collapse 1017 on which the cavitation can have an effect.

Yet another type of printhead nozzle arrangement suitable for the present invention will now be described with reference to Figs. 34 – 36. This type typically provides an ink delivery nozzle arrangement having a nozzle chamber containing ink and a thermal bend actuator connected to a paddle positioned within the chamber. The thermal actuator device is actuated so as to eject ink from the nozzle chamber. The preferred embodiment includes a particular thermal bend actuator which includes a series of tapered portions for providing conductive heating of a conductive trace. The actuator is connected to the paddle via an arm received through a slotted wall of the nozzle chamber. The actuator arm has a mating shape so as to mate substantially with the surfaces of the slot in the nozzle chamber wall.

Turning initially to Figs. 34(a)-(c), there is provided schematic illustrations of the basic operation of a nozzle arrangement of this embodiment. A nozzle chamber 501 is provided filled with ink 502 by means of an ink inlet channel 503 which can be etched through a wafer substrate on which the nozzle chamber 501 rests. The nozzle chamber 501 further includes an ink ejection port 504 around which an ink meniscus forms.

Inside the nozzle chamber 501 is a paddle type device 507 which is interconnected to an actuator 508 through a slot in the wall of the nozzle chamber 501. The actuator 508 includes a heater means e.g. 509 located adjacent to an end portion of a post 510. The post 510 is fixed to a substrate.

When it is desired to eject a drop from the nozzle chamber 501, as illustrated in Fig. 34(b), the heater means 509 is heated so as to undergo thermal expansion. Preferably, the heater means 509 itself or the other portions of the actuator 508 are built from materials having a high bend efficiency where the bend efficiency is defined as:

$$bend\ \ efficiency = \frac{Young's\ \ Modulus \times (Coefficient\ \ of\ \ thermal\ \ Expansion)}{Density \times Specific\ \ Heat\ \ Capacity}$$

A suitable material for the heater elements is a copper nickel alloy which can be formed so as to bend a glass material.

The heater means 509 is ideally located adjacent the end portion of the post 510 such that the effects of activation are magnified at the paddle end 507 such that small thermal expansions near the post 510 result in large movements of the paddle end.

The heater means 509 and consequential paddle movement causes a general increase in pressure around the ink meniscus 505 which expands, as illustrated in Fig. 34(b), in a rapid manner.

The heater current is pulsed and ink is ejected out of the port 504 in addition to flowing in from the ink channel 503.

Subsequently, the paddle 507 is deactivated to again return to its quiescent position. The deactivation causes a general reflow of the ink into the nozzle chamber. The forward momentum of the ink outside the nozzle rim and the corresponding backflow results in a general necking and breaking off of the drop 512 which proceeds to the print media. The collapsed meniscus 505 results in a general sucking of ink into the nozzle chamber 502 via the ink flow channel 503. In time, the nozzle chamber 501 is refilled such that the position in Fig. 34(a) is again reached and the nozzle chamber is subsequently ready for the ejection of another drop of ink.

Fig. 35 illustrates a side perspective view of the nozzle arrangement. Fig. 36 illustrates sectional view through an array of nozzle arrangement of Fig. 35. In these figures, the numbering of elements previously introduced has been retained.

Firstly, the actuator 508 includes a series of tapered actuator units e.g. 515 which comprise an upper glass portion (amorphous silicon dioxide) 516 formed on top of a titanium nitride layer 517. Alternatively a copper nickel alloy layer (hereinafter called cupronickel) can be utilized which will have a higher bend efficiency.

The titanium nitride layer 517 is in a tapered form and, as such, resistive heating takes place near an end portion of the post 510. Adjacent titanium nitride/glass portions 515 are interconnected at a block portion 519 which also provides a mechanical structural support for the actuator 508.

The heater means 509 ideally includes a plurality of the tapered actuator unit 515 which are elongate and spaced apart such that, upon heating, the bending force exhibited along the axis of the actuator 508 is maximized. Slots are defined between adjacent tapered units 515 and allow for slight differential operation of each actuator 508 with respect to adjacent actuators 508.

The block portion 519 is interconnected to an arm 520. The arm 520 is in turn connected to the paddle 507 inside the nozzle chamber 501 by means of a slot e.g. 522 formed in the side of the nozzle chamber 501. The slot 522 is designed generally to mate with the surfaces of the arm 520 so as to minimize opportunities for the outflow of ink around the arm 520. The ink is held generally within the nozzle chamber 501 via surface tension effects around the slot 522.

When it is desired to actuate the arm 520, a conductive current is passed through the titanium nitride layer 517 within the block portion 519 connecting to a lower CMOS layer 506 which provides the necessary power and control circuitry for the nozzle arrangement. The conductive current results in heating of the nitride layer 517 adjacent to the post 510 which results in a general upward bending of the arm 20 and consequential ejection of ink out of the nozzle 504. The ejected drop is printed on a page in the usual manner for an inkjet printer as previously described.

An array of nozzle arrangements can be formed so as to create a single printhead. For example, in Fig. 36 there is illustrated a partly sectioned various array view which comprises multiple ink ejection nozzle arrangements laid out in interleaved lines so as to form a printhead array. Of course, different types of arrays can be formulated including full color arrays etc.

The construction of the printhead system described can proceed utilizing standard MEMS techniques through suitable modification of the steps as set out in US 6,243,113 entitled "Image Creation Method and Apparatus (IJ 41)" to the present applicant, the contents of which are fully incorporated by cross reference.

The integrated circuits 74 may be arranged to have between 5000 to 100,000 of the above described ink delivery nozzles arranged along its surface, depending upon the length of the integrated circuits and the desired printing properties required. For example, for narrow media it may be possible to only require 5000 nozzles arranged along the surface of the printhead assembly to achieve a desired printing result, whereas for wider media a minimum of 10,000, 20,000 or 50,000 nozzles may need to be provided along the length of the printhead assembly to achieve the desired printing result. For full colour photo quality images on A4 or US letter sized media at or around 1600dpi, the integrated circuits 74 may have 13824 nozzles per color. Therefore, in the case where the printhead assembly 22 is capable of printing in 4 colours (C, M, Y, K), the integrated circuits 74 may have around 53396 nozzles disposed along the surface thereof. Further, in a case where the printhead assembly 22 is capable of printing 6 printing fluids (C, M, Y, K, IR and a fixative) this may result in 82944 nozzles being provided on the surface of the integrated circuits 74. In all such arrangements, the electronics supporting each nozzle is the same.

The manner in which the individual ink delivery nozzle arrangements may be controlled within the printhead assembly 22 will now be described with reference to Figs. 37 – 40.

Fig. 37 shows an overview of the integrated circuit 74 and its connections to the SoPEC device (discussed above) provided within the control electronics of the print engine 1. As discussed above, integrated circuit 74 includes a nozzle core array 901 containing the repeated logic to fire each nozzle, and nozzle control logic 902 to generate the timing signals to fire the nozzles. The nozzle control logic 902 receives data from the SoPEC device via a high-speed link.

The nozzle control logic 902 is configured to send serial data to the nozzle array core for printing, via a link 907, which may be in the form of an electrical connector. Status and other operational information about the nozzle array core 901 is communicated back to the nozzle control logic 902 via another link 908, which may be also provided on the electrical connector.

The nozzle array core 901 is shown in more detail in Figs. 38 and 39. In Fig. 38, it will be seen that the nozzle array core 901 comprises an array of nozzle columns 911. The array includes a

fire/select shift register 912 and up to 6 color channels, each of which is represented by a corresponding dot shift register 913.

As shown in Fig. 39, the fire/select shift register 912 includes forward path fire shift register 930, a reverse path fire shift register 931 and a select shift register 932. Each dot shift register 913 includes an odd dot shift register 933 and an even dot shift register 934. The odd and even dot shift registers 933 and 934 are connected at one end such that data is clocked through the odd shift register 933 in one direction, then through the even shift register 934 in the reverse direction. The output of all but the final even dot shift register is fed to one input of a multiplexer 935. This input of the multiplexer is selected by a signal (corescan) during post-production testing. In normal operation, the corescan signal selects dot data input Dot[x] supplied to the other input of the multiplexer 935. This causes Dot[x] for each color to be supplied to the respective dot shift registers 913.

A single column N will now be described with reference to Fig. 40. In the embodiment shown, the column N includes 12 data values, comprising an odd data value 936 and an even data value 937 for each of the six dot shift registers. Column N also includes an odd fire value 938 from the forward fire shift register 930 and an even fire value 939 from the reverse fire shift register 931, which are supplied as inputs to a multiplexer 940. The output of the multiplexer 940 is controlled by the select value 941 in the select shift register 932. When the select value is zero, the odd fire value is output, and when the select value is one, the even fire value is output.

Each of the odd and even data values 936 and 937 is provided as an input to corresponding odd and even dot latches 942 and 943 respectively.

Each dot latch and its associated data value form a unit cell, such as unit cell 944. A unit cell is shown in more detail in Fig. 40. The dot latch 942 is a D-type flip-flop that accepts the output of the data value 936, which is held by a D-type flip-flop 944 forming an element of the odd dot shift register 933. The data input to the flip-flop 944 is provided from the output of a previous element in the odd dot shift register (unless the element under consideration is the first element in the shift register, in which case its input is the Dot[x] value). Data is clocked from the output of flip-flop 944 into latch 942 upon receipt of a negative pulse provided on *LsyncL.*

The output of latch 942 is provided as one of the inputs to a three-input AND gate 945. Other inputs to the AND gate 945 are the Fr signal (from the output of multiplexer 940) and a pulse profile signal Pr. The firing time of a nozzle is controlled by the pulse profile signal Pr, and can be, for example, lengthened to take into account a low voltage condition that arises due to low power supply (in a removable power supply embodiment). This is to ensure that a relatively consistent amount of ink is efficiently ejected from each nozzle as it is fired. In the embodiment described, the profile signal Pr is the same for each dot shift register, which provides a balance between complexity,

cost and performance. However, in other embodiments, the Pr signal can be applied globally (ie, is the same for all nozzles), or can be individually tailored to each unit cell or even to each nozzle.

Once the data is loaded into the latch 942, the fire enable Fr and pulse profile Pr signals are applied to the AND gate 945, combining to the trigger the nozzle to eject a dot of ink for each latch 942 that contains a logic 1.

The signals for each nozzle channel are summarized in the following table:

Name	Direction	Description
D	Input	Input dot pattern to shift register bit
Q	Output	Output dot pattern from shift register bit
SrClk	Input	Shift register clock in – d is captured on rising edge of this clock
LsyncL	Input	Fire enable – needs to be asserted for nozzle to fire
Pr	Input	Profile – needs to be asserted for nozzle to fire

As shown in Fig. 40, the fire signals Fr are routed on a diagonal, to enable firing of one color in the current column, the next color in the following column, and so on. This averages the current demand by spreading it over 6 columns in time-delayed fashion.

The dot latches and the latches forming the various shift registers are fully static in this embodiment, and are CMOS-based. The design and construction of latches is well known to those skilled in the art of integrated circuit engineering and design, and so will not be described in detail in this document.

The nozzle speed may be as much as 20 kHz for the printer unit 2 capable of printing at about 60 ppm, and even more for higher speeds. At this range of nozzle speeds the amount of ink than can be ejected by the entire printhead assembly 22 is at least 50 million drops per second. However, as the number of nozzles is increased to provide for higher-speed and higher-quality printing at least 100 million drops per second, preferably at least 500 million drops per second and more preferably at least 1 billion drops per second may be delivered. At such speeds, the drops of ink are ejected by the nozzles with a maximum drop ejection energy of about 250 nanojoules per drop.

Consequently, in order to accommodate printing at these speeds, the control electronics must be able to determine whether a nozzle is to eject a drop of ink at an equivalent rate. In this regard, in some instances the control electronics must be able to determine whether a nozzle ejects a drop of ink at a rate of at least 50 million determinations per second. This may increase to at least 100 million

determinations per second or at least 500 million determinations per second, and in many cases at least 1 billion determinations per second for the higher-speed, higher-quality printing applications.

For the printer unit 2 of the present invention, the above-described ranges of the number of nozzles provided on the printhead assembly 22 together with the nozzle firing speeds and print speeds results in an area print speed of at least 50 cm^2 per second, and depending on the printing speed, at least 100 cm^2 per second, preferably at least 200 cm^2 per second, and more preferably at least 500 cm^2 per second at the higher-speeds. Such an arrangement provides a printer unit 2 that is capable of printing an area of media at speeds not previously attainable with conventional printer units.

MAINTENANCE ASSEMBLY

The maintenance assembly 23 is shown in detail in Figs. 41 – 44, and as previously shown in Fig 8, it is mounted between the posts 26 of the main body 20, so as to be positioned adjacent the printhead assembly 22.

The maintenance assembly 23 generally consists of a maintenance chassis 88 which receives the various components of the assembly therein. The maintenance chassis 88 is in the form of an open ended channel having a pair of upwardly extending tongue portions 89 at its ends which are shaped to fit over the posts 26 of the main body 20 and engage with the retaining projections provided thereon to secure the maintenance assembly 23 in position. The maintenance chassis 88 is made from a suitable metal material, having rigidity and resilience, such as a pressed steel plate.

The base of the maintenance chassis 88 is shown more clearly in Fig. 43 and includes a centrally located removed portion 90, window portions 92 and spring arms 91 extending from either side of the window portions 92. The integral spring arms 91 are angled internally of the chassis 88 and formed by pressing the sheet metal of the chassis. Of course the spring arms 91 could equally be a separate insert placed into the open channel of the chassis 88.

A rigid insert 93 is provided to fit within the chassis 88 to provide added rigidity to the maintenance assembly 23. A catch element 94 projects from the base of the rigid insert and extends into the centrally located removed portion 90 of the chassis 88 when the rigid insert 93 is located within the chassis 88. The catch element 94 is provided to move the maintenance assembly between a capped and an uncapped state, as will be described below. A lower maintenance molding 95 is located within the insert 93 and retained within the insert via engagement of a number of lugs 96 formed along the sides of the lower maintenance molding 95 with corresponding slots 97 provided along the sides of the insert 93. The lower maintenance molding 95 is made from a suitable plastic material and forms a body having closed ends and an open top. The ends of the lower maintenance

molding 93 are provided with air vents 98. Air from the vents 98 flows through filters 181 to ventilate the maintenance assembly.

Two pin elements 99 extend from the base of the lower maintenance molding 95. The pin elements 99 are connected to the base via a flexible web, such as rubber, to allow multi-directional relative movement of the pin elements 99 with respect to the base of the lower maintenance molding. The pin elements 99 pass through two circular openings 100 in the base of the rigid insert 93 and into the window portions 92 of the maintenance chassis 88.

A retainer insert 101 is supported on the pin elements 99 within the lower maintenance molding 95. The retainer insert 101 is coated steel and provides rigid support for the strips of absorbent media 102 retained therein. The absorbent media 102 is a generally an inverted T-shaped assembly of separate portions – a thin vertical portion which extends upwardly from between two substantially horizontal portions. The absorbent media 102 may be made from any type of material capable of absorbing and retaining ink such as urethane foam or the like.

A microfibre fabric 103 fits over the thin vertical portion, around the two horizontal portions, and then attaches to the retainer insert 101 to retain the absorbent media 102. The microfibre fabric 103 draws into the absorbent media 102.

An upper maintenance molding 104 fits over the lower maintenance molding 95 to enclose the microfibre fabric 103, absorbent media 102 and retainer insert 101 therebetween. The upper maintenance molding 104 is attached along its bottom surface to the surface of the lower maintenance molding 95 via an appropriate adhesive. An upwardly projecting rim portion 105 extends beyond the thin vertical portion of the absorbent media 102 covered with microfibre fabric 103. The rim portion 105 defines an open perimeter seal for sealing the nozzles of the printhead assembly 22 when the upper maintenance molding 104 is brought into capping contact with the printhead assembly.

In this arrangement, the upper maintenance molding 104, microfibre fabric 103, absorbent media 102, retainer insert 101, lower maintenance molding 95 and the rigid insert 93 form a capping unit which is adapted to fit within the maintenance chassis 88 and is supported on the spring arms thereof. Within this unit, the microfibre fabric 103, absorbent media 102 and the retainer insert 101 form a sub-unit supported on the pin elements 99 and movable within the space defined by the lower maintenance molding 95 and the upper maintenance molding 104.

As shown in Fig 41, the capping unit is held in place with a retainer element 106 that fits over the upper maintenance molding 104 and secures to the chassis 88. The retainer element 106 is essentially in the form of an open ended channel having a slot 107 formed along the upper surface thereof, through which the rim portion 105 of the upper maintenance molding 104 can protrude and

cappingly engage with the printhead assembly 22. The upper surface of the retainer element 106 is curved and acts as a media guide during printing.

When assembled in this manner, the components of the maintenance assembly 23 are contained within the retainer element 106 and the chassis 88, such that both the upper maintenance molding 104 can move with respect to the retainer element 106 to cap the printhead assembly 22, and the microfibre fabric 103 and absorbent media 102 can move with respect to the upper maintenance molding to contact and wipe the surface of the nozzles of the printhead assembly 22.

Upon assembly and attachment of the maintenance assembly 23 to the posts 26 of the main body 20, the catch element 94 of the rigid insert extends from the central removed portion 90 of the chassis 88. Due to the action of the spring arms 91, the maintenance unit 23 (as previously defined) is raised from the base of the chassis 88 such that the rim portion 105 of the upper maintenance molding 104 extends through the slot 107 of the retainer element 106 and is in capping contact with the printhead assembly 22. This state is shown in Fig. 44 and is referred to as the capping state, whereby the nozzles of the printhead are sealed in an almost closed environment within the rim portion 105 and are less likely to dry out and clog with ink. The environment is almost closed and not fully closed, so that the maintenance assembly is not prevented from moving to the uncapped state because of a mild vacuum created within the rim 105.

To remove any paper dust or other particulate matter present in the vicinity of the nozzles of the printhead assembly 22, the surface of the printhead may be wiped by the microfibre fabric 103. To perform this, a wiper actuator present in the cradle unit extends into the window portions 92 of the chassis 88 and contacts the pin elements 99 provided in the base of the lower maintenance molding 95. Any upward force provided by the wiper actuator on the pins 99 causes them to project further against the retainer insert 101, thereby causing the vertical portion of the absorbent media 102, which is coated with the microfibre fabric 103, to extend into and beyond the rim portion 105 of the upper maintenance molding 104, until it contacts the surface of the printhead assembly 22 proximal the nozzles. The presence of the microfibre fabric 103 ensures that contact is minimised and attracts any ink or moisture present on the surface of the printhead assembly 22 to be retained within the absorbent media 102. As the pins 99 are free to move in any direction, any lateral motion of the wiper actuator will cause the microfibre fabric 103 to move laterally across the surface of the nozzles hence performing a wiping or cleaning function. Removal of the wiper actuator will then cause the arrangement to return to a position whereby the microfibre fabric 103 and the absorbent media 102 are below the surface of the rim portion 105.

In order to perform printing, the maintenance assembly 23 must be moved from the capping state to a printing state. This is achieved by a maintenance actuator gripping the catch element 94

projecting through the central removed portion 90 of the chassis 88 and applying a downward force thereto. This downward force causes the rigid insert 93 to move against the spring arms 91 of the chassis 88, towards the base of the chassis. This movement causes the upper rim portion 105 of the upper capping molding 104 to retract into the slot 107 formed in the retainer element 106 such that it is flush with the outer surface of the retainer element 106 and does not protrude therefrom. It will be appreciated that the retainer element 106 does not move and is fixed in position. This creates a gap between the retainer element 106 and the printhead assembly 22 through which the media can pass for printing. In the printing or uncapped state, the retainer element 106 acts as a media guide and the media contacts the retainer element and is supported on the surface of the retainer element 106 as it passes the printhead assembly for printing.

Cradle unit

The cradle unit 12 is shown in relation to Figs 6 and 7 and generally consists of a main body 13 which defines an opening 14 for receiving the cartridge unit 10, and a cover assembly 11 adapted to close the opening to secure the cartridge unit 10 in place within the cradle unit 12.

The main body 13 of the cradle unit 12 includes a frame structure 110 as shown in Fig. 45A and 45B. The frame structure 110 generally comprises two end plates 111 and a base plate 112 connecting each of the end plates 111. A drive roller 113 and an exit roller 114 are mounted between the end plates 111 at opposing ends thereof, such that when the cartridge unit 10 is retained within the main body 13, it sets between the drive roller 113 and exit roller 114. The drive roller 113 and the exit roller 114 are each driven by a brushless DC motor 115 which is mounted to one of the end plates 111 and drives each of the drive and exit rollers via a drive mechanism 116, such as a drive belt. Such a system ensures that both the drive roller 113 and the exit roller 114 are driven at the same speed to ensure a smooth and consistent passage of the media through the print engine 1 and past the printhead assembly 22 of the cartridge unit 10.

A maintenance drive assembly 117 is mounted to the other end plate 111, opposite the DC motor 107. The maintenance drive assembly 117 comprises a motor 118 which is operatively connected to a maintenance gear 119 and a wiper gear 120. The maintenance gear 119 is in turn connected to a maintenance actuator 121 which is in the form of a rod having a hooked end that extends a distance within the base plate 112. The hooked end of the maintenance actuator 121 is shaped to be received within the catch element 94 of the maintenance assembly 23 so as to raise/lower the upper rim portion 105 between the capping state and the printing state. The wiper gear 120 is similarly connected to a wiper actuator 122 in the form of a rod having a pair of

projections extending therefrom. The wiper actuator 122 similarly extends within the base plate 112, and the projections are positioned along the wiper actuator 122 so that they are aligned with the window portions 92 formed in the base of the maintenance chassis 88 so as to contact the pin elements 99 of the maintenance assembly 23.

The maintenance drive assembly 117 is shown in isolation in Figs 46A and 46B. As the motor 118 is bi-directional, operation of the motor in one direction will cause the wiper gear 120 to move in a counter-clockwise direction as shown in Fig 46A. The wiper gear 120, has a raised portion 123 formed on the surface thereof which comes into contact with an arm 124 of the wiper actuator as the wiper gear 120 rotates. As the raised portion 123 contacts the arm 124, the wiper actuator 122 pivots such that the projections formed thereon move in an upward direction through the window portions 92 in the maintenance chassis 88 and against the pin elements 99, thereby bring the micro fibre fabric 103 against the surface of the printhead assembly. Further rotation of the wiper gear 120 will result in the arm 124 returning to its neutral position. Lateral movement can be applied to the wiper actuator 122 due to the presence of an additional angled raised portion 125 formed on the wiper gear 120 upon which the arm 124 rides causes the entire wiper actuator to move laterally against the returning spring 126. A sensor element 127 is provided to sense the position of the wiper actuator such that the state of the printhead can be readily determined.

In order to control the capping state of the printhead assembly 22, the motor 118 is reversed resulting in the wiper gear 120 moving in a clockwise direction as shown in Fig. 46A and a counter-clockwise direction as shown in Fig. 46B. Rotation of the wiper gear 120 in this direction ensures that the wiper actuator pivots in a downward direction away from the maintenance assembly 23. However as shown more clearly in Fig. 46B, this rotation causes a flipper gear 128 provided on the inner surface of the wiper gear 120 to engage with the maintenance gear 119 and in turn cause the maintenance gear 119 to rotate in a counter clockwise direction (as shown in Fig. 46B). Similarly, a projection 129 formed on the inner surface of the maintenance gear 119 contacts a pivot arm 130 of the maintenance actuator 121, thereby causing the hooked end of the maintenance actuator to move in a downward direction, which in turn grips the catch element 94 of the maintenance assembly 23 causing the upper rim portion 105 to retract and assume a printing state. Similarly, the sensor element 127 can sense the position of the maintenance actuator to control operation of the motor 118, and hence the desired state of the printhead.

Referring again to Figs. 45A and 45B, a pair of cartridge unit guides 131 are attached to the end plates 111 to aid in receiving and guiding the cartridge unit 10 into the cradle unit 12. The guides 131 are angled to receive a surface of the cartridge unit 10 such that the cartridge unit 10 is orientated correctly with respect to the cradle unit 12.

The control electronics for controlling the operation of the print engine and the ICs 50 of the printhead assembly 22 is provided on a printed circuit board (PCB) 132. As shown in Fig 45A, one face of the PCB 132 contains the SoPEC devices 133 and related componentry 134 for receiving and distributing the data and power received from external sources, whilst the other face of the PCB includes rows of electrical contacts 135 along a lower edge thereof which provides a means for transmitting the power and data signals to the corresponding electrical contacts on the flex PCB 79 for controlling the nozzles of the printhead assembly 22.

As shown in isolation in Fig. 47, the PCB 132 forms part of a PCB assembly 140, and is mounted between two arms 136, with each of the arms having a claw portion 137 to receive and retain the PCB 132 in position. As shown in Fig. 48, each of the arms 136 has a groove 141 formed in the upper portion thereof for receiving a hook portion of a tension spring 142, the purpose of which will be described below.

In order to provide stability to the PCB 132 as it is mounted between the two arms 136, a support bar 138 is secured to the arms 136 and the PCB along the bottom edge of the PCB 132, on the face that contains the SoPEC devices 133 and the related componentry 134. The support bar 138 has a plurality of star wheels 139 mounted along its lower surface. The star wheels are spring loaded such that they can move relative to the lower surface of the support bar to grip with a surface of the exit roller 114 when the PCB assembly 140 is mounted to the end plates 111, as shown in Fig 45A.

A heatshield 143 is attached to the PCB 132, as shown in Fig. 49A such that it substantially covers the SoPEC devices 133 and protects the SoPEC devices from any EMI that may be within the vicinity of the printer unit 2. The heatshield 143 also has a latch mechanism 144 provided therein which mates with a clip provided on the cover assembly 11 to secure the cover assembly in a closed position as shown in Fig. 49A.

The PCB assembly 140 is pivotally mounted to the end plates 111 at pivot points 141 provided at the bottom of the arms 136. In this arrangement, the PCB assembly 140 is able to swing about its pivot points 141 between an open position, wherein the electrical contacts 135 are remote from the electrical contacts of the flex PCB 79 and the cartridge unit 10 can be readily removed from the cradle unit 12, and a closed position, where the electrical contacts 135 are in operational contact with the electrical contacts provided on the flex PCB 79 to transmit control data and power to facilitate printing from the nozzles of the printhead assembly 22.

As shown in Fig 49B, an idle roller assembly 145 is secured to the end plates 111 at the rear of the cradle unit 12 and includes a plurality of roller wheels 146 which are positioned to contact the surface of the drive roller 113 and rotate therewith. The idle roller assembly 145 ensures that any media that is presented to the print engine 1 from the picker mechanism 9 of the printer unit 2, is

gripped between the drive roller 113 and the roller wheels 146 of the idle roller assembly 1145 for transport past the printhead assembly 22 of the cartridge unit 10 for printing.

The cover assembly 11, is shown in its closed position in Figs. 49A and 49B, and is pivotally attached to the end plates 111 at an upper rear portion thereof. A pair of attachment plates 147 extend from the cover assembly 11 for attaching the cover assembly to the end plates 111 via a pin 148. The attachment plates 147 extend beyond the pin 148 and have a hole formed therein into which is received the free end of the tension spring 142 as discussed previously in relation to Fig. 48.

When the cover assembly 11 is in the closed position, as shown in Fig. 49B, the spring is in full tension which in turn causes the PCB assembly 40 to pivot towards the closed position, as shown in cross-section in Fig. 50A. In this position, the electrical contacts 135 of the PCB 132 are in operational contact with the corresponding electrical contacts of the flex PCB 79 of the printhead assembly 22 such that power and data signals can be transferred therebetween.

When the cover assembly is moved to its open position, as shown in Fig 49C, the attachment plates 147 pivot towards the front of the cradle assembly thereby relieving tension in the spring 142 and causing the spring to become slack. This in turn, allows the PCB assembly to pivot away into an open position as shown in Fig. 50B. In this position, the electrical contacts 135 of the PCB 132 move away from contacting the corresponding contacts of the flex PCB 79 of the printhead assembly 22, to thereby enable the cartridge unit 10 to be removed from the cradle unit 12.

In this regard, the act of opening/closing the cover assembly 11 also performs the function of disengaging/engaging electrical communication between the cartridge unit 10 and the cradle unit 12.

Referring again to Figs. 49A – 49C, the cover assembly 11 includes a number of docking ports 149 formed in the upper surface thereof. In the embodiment shown there are five docking ports 149 provided, with each docking port corresponding to one of the ink storage modules 45. Each docking port 149 has an upwardly projecting lip portion which is shaped to receive an ink refill unit for supplying refill ink to the ink storage modules 45. As more clearly shown in Fig. 49C, each docking port 149 has a large, substantially circular opening 151 and two small circular openings 152 provided therein, which enable the delivery of ink between the ink refill unit and the cartridge unit 10 to occur in the manner as described below.

Four T-shaped openings 182 are positioned at the corners of each docking portion 149 to receive the bag constrictor actuators on the refill. These were briefly discussed above in relation to the ink storage modules 45 and are described in more detail below.

Refill Unit

Figs. 51A – 51C show the ink refill unit 155 for supplying refill ink to the cartridge unit 10. The ink refill unit 155 is provided as a unit comprising a base assembly 156 which houses internal ink refilling components and a cover 157 which fits over the base assembly 156. The base assembly and cover may be moulded from a plastics material and the base assembly 156 may be moulded as a single piece or in sections.

The underside of the base assembly 156 is shown in more detail in Fig. 51B and includes a ridge portion 160 that projects therefrom and which mates with docking port 149 formed in the cover assembly 11, to retain the ink refill unit in docking position. A substantially cylindrical ink outlet 158 also projects from the underside of the base assembly for delivering ink into the cartridge unit 10. A two valve actuating pins 159 also project from the underside of the base assembly 156 for actuating the inlet and outlet valves of the ink storage modules 45 respectively. In the embodiment shown, the two valve actuating pins 159 have a tri star cross section for good uni-directional bending resistance and buckling strength. A QA chip 161 is also provided to project from the underside of the base assembly 156 and has a plurality of QA chip contacts 162 exposed thereon which are read by a QA chip reader provided in the cover assembly 11 when the ink refill unit 155 is docked therewith.

A constrictor actuator 190 projects from adjacent each corner of the base assembly 156. The constrictor actuators 190 are slightly arcuate and rounded at their ends. The constrictor apertures 60 (see Fig. 14) in the top 42 of the cartridge unit 10, are correspondingly arcuate. The rounded ends and arcuate cross section allow the user to easily align one constrictor actuator 190 with its corresponding aperture 60, and the curved surfaces intuitively guide the other constrictor actuators 190 into alignment with their respective apertures 60. This helps to dock the refill unit with the interface 61 quickly and with minimal fine positioning by the user. As best shown in Fig. 51B, each constrictor actuator 190 has a buttress reinforcement 191. This gives the constrictor actuators 190 a high bending strength in order to withstand large lateral forces in the event that users apply excessive force when aligning the refill unit with the docking port.

As described above with reference to Fig. 12, the constrictor actuators 190 actuate the bag constrictor 43 of the ink storage module 45.

The base assembly 156 also has a filling port 192. The bag 163 receives its initial charge of ink through this port which is then sealed with a plastic sealing ball 193.

Referring to the exploded view of Fig. 51C, an ink bag 163 is sealed to the inner surface of the base assembly 156 for storing the refill ink therein, and is made from a deformable material which allows the ink bag 163 to expand/collapse as ink is supplied to/removed from the ink refill unit 155. An ink delivery needle 164 extends into the space provided between the bag 163 and the base assembly 156 and provides a passage for ink to flow to the outlet 158. The end of the ink delivery

needle 164 extends into the cylindrical outlet 158, and is surrounded by a seal ring 165 which is spring loaded via a compression spring 166 within the open end of the cylindrical outlet 158. When the ink refill unit 155 is not docked with the cartridge unit 10, the delivery needle is protected by the seal ring 165. As a further precaution, a plastic cap 187 is slid over the outlet and held in place by a slight interference fit.

An ink level indicator 167 is also provided within the cover 157 of the ink refill unit 155. The ink level indicator 167 comprises a flexible strip having an indication portion 168, such as a coloured section. The strip is attached to the upper surface of the deformable ink bag 163 at its ends and to the underside of the cover 157 at its centre, so that when the ink supply within the bag 163 is exhausted, i.e., the bag is substantially empty, the indication portion 168 aligns itself with a transparent window 169 provided in the top surface of the cover 157. In this regard, at any other time, i.e., when the bag is other than substantially empty, the indication portion is hidden from view.

As the ink dispenses, the nature of the ink bag material causes it to deform and collapse in a non-uniform manner. Each of the edges of the upper surface of the bag are unlikely to collapse at the same rate. As such, the length of the ink level indicator 167 is ensures that the indication portion 168 only aligns with the window 169 in the cover 157 once all of the edges of the deformable bag's upper surface have fully collapsed. The ink level indicator strip 282 is initially in a folded state with the indication portion 168 being located on the strip 282 so as to be hidden from the window 169 when the bag 163 is full. The strip 167 is attached at either end to opposite edges of the bag's upper surface. A point (not shown) intermediate the ends is secured beneath the transparent window 169. When the bag 46 fully collapses the strip 167 lengthens and unfolds. This brings the previously hidden indication portion 168 into view through the window 169. The use of the ink level indicator 167 means that the one refill unit 155 can be used for multiple refill operations if the refill unit is not fully exhausted. This may occur when the amount of ink necessary for refilling the corresponding ink storage module 45 of the cartridge unit 10 in one operation is less than the capacity of the refill unit.

The cover 157 fits over a portion of the base assembly 156 to enclose the ink bag 163 and ink level indicator 167. Likewise, U-shaped docking clasp 183 fits over the cover 157 such that its legs extend beyond the base assembly 156 to engage the cartridge unit 10 when docked. Clips 170 on opposing legs of the clasp 183 snap lock onto the sides of the cartridge unit 10. This holds the refill unit 155 substantially fixed relative the cover assembly 11 for reliable and efficient transfer of ink.

An opposing pair of leaf springs 184 extend from inside each leg of the U-shaped clasp to press against the sides of the cover 157. Adjacent each leaf spring is a pivot 185 designed to engage a fulcrum ledge 186 on the side of the cover 157. This pushes the legs outwardly, however as the

pivot 185 engages the fulcrum 186, the clips are levered inwardly to maintain engagement with the cartridge unit 10.

A label panel 188 is fixed to the outer surface of the clasp 183. The label panel 188 can display trademark and other information. It may also be coloured to match the ink within the refill. The label panel 188 also has finger grip pads 189 on each leg. The finger grip pads 189 are positioned so that finger pressure at these points will overcome the force of the leaf springs 184 to lever the clips 170 out of engagement with cartridge unit 10. The refill unit 155 may then be pulled off the docking port 149 of the cover assembly 11.

Fig. 52 shows the refill unit 155 docked directly with one of the interfaces 61 of the ink storage module assembly 11 of the cartridge unit 10. The cover assembly 11 and remainder of the cradle unit have been removed for clarity. The refill unit 155 is shaped, or 'keyed', such that it can only be received within the docking port 149 in one particular orientation. The ends of each leg of the U-shapes clasp 183 are significantly different widths so that the user is less likely attempt to dock the unit 155 back-to-front. The cylindrical ink outlet 158 is offset from the lateral centre line to also guard against back-to-front docking of the refill unit 155. As previously discussed, the base of the docking port 149 has a large circular opening 151, into which is received the cylindrical ink outlet 158, and two smaller openings 152, into which the valve actuators 159 are received. The cross sections of each of these interacting elements are shaped so that only the correctly coloured ink refill unit, in the correct orientation, can be used to refill each particular ink storage module 45. For example, the two tri star cross sections of the valve actuators 159 can each be rotated to give a large number of combinations that will only mate with corresponding tri star apertures, each with a matching rotational orientation.

A QA chip reader 172 is also provided in the base of the docking port 149 for mating with the QA chip contacts 162 of the QA chip 161 of the refill unit 155 and reading and receiving information stored thereon. Such information may include the storage capacity of the refill unit 155 (e.g., about 30 to about 50 ml), the colour of the ink contained within the refill unit 155, and the source of the ink contained within the ink refill unit 155. The information can be readily transferred to the control circuitry of the cradle unit 12 when the refill unit 155 is docked into position within the docking port 149. For example, the control circuitry of the cradle unit 12 is able to determine which of the ink storage modules 45 require refilling and whether the refill unit 155 contains the correct type/colour and amount of ink to facilitate refilling.

As shown more clearly in Fig 53, the valve insert 49 of each of the ink storage modules 45 (see Fig.10) is arranged such that the ink inlet 15 is aligned with the large circular opening 151 formed in the docking port 149, and the ink inlet and outlet valves 16 and 18 respectively (obscured

by the tri star openings 152), are aligned with the smaller circular openings 252. As the ink refill unit 155 is brought into position within the docking port 149, the ink outlet 158 of the refill unit 155 contacts the ink inlet 15 of the ink storage assembly 45, and the valve actuator pins 159 contact each of the ink inlet valve 16 and ink outlet valve 18.

In this position, the ink delivery needle 164 penetrates the ink inlet 15 of the valve insert 49 as the spring loaded seal ring 165 retracts within the cylindrical ink outlet 158 to form a tight seal around the surface of the ink inlet 15. The seal ring 165 is able to 'ride' up the ink delivery needle 164 and is loaded such that upon removal of the refill unit 155 from the docking port 149, the seal ring is returned to its protection position via action of a seal spring 166.

As discussed previously, the ink retained within ink bag 46 of the ink storage module 45 is in a constant state of negative pressure due to the spring element 54 applying a constant expansion force to the ink bag 46. This produces a negative or back pressure in the ink, thereby preventing ink from leaking from the nozzles of the printhead assembly 22. This back pressure also provides a simple means for extracting the refill ink from the refill unit 155 when the refill unit is docked into position. Due to a pressure gradient between the ink bag of the refill unit 155 (which is at atmospheric pressure) and the ink bag of the ink storage module 45, when the ink delivery needle 164 penetrates the ink inlet 15, the refill ink simply flows from the refill init 155 into the ink bag 46 of the ink storage module 45.

In order to alternate between a refilling operation and a printing operation and to maintain the ink in the printhead assembly 22 in a constant state of back pressure such that ink does not leak from the nozzles during refilling, valves 16 and 18 are provided in the valve insert as discussed above. Both valves are controlled by the valve actuator pins 159 when the refill unit is docked into position with the docking port 149. The manner in which the valves are controlled is shown with reference to Figs. 54A – 54D.

Figs. 54A and 54B show different cross-sectional views respectively along lines A-A and B-B in Fig. 53 illustrating a state of the valve arrangement before refilling, and Figs. 54C and 54D respectively show the views of Figs. 54A and 54B illustrating a state of the valve arrangement during refilling.

Prior to refilling, as shown in Figs. 54A and 54B, the ink inlet valve 16 is in a closed position, thereby preventing the passage of ink or air from entering the ink inlet 15 and making its way into the ink bag 46. This is shown in Fig. 54B, whereby any ink present in the passage between the ink inlet 15 and the ink inlet valve 16 remains in this space. An o-ring seal is provided at the ink inlet 15 to maintain an air tight seal around the ink delivery needle 164 of the refill unit 155. In this state, the ink outlet valve 18 is in an open position thereby providing a passage for ink to flow out the

ink outlet 52, down the ink downpipe 30 and to the printhead assembly 22. As discussed, the spring element 54 establishes a state of back pressure within the ink bag 46, and the printhead 22 draws the ink from the ink bag 46 against this back pressure during printing.

During refilling, as shown in Figs. 54C and 54D, the ink refill unit 155 is docked into the docking port 149 such that the ink outlet 158 engages with the ink inlet 15 of the valve insert 49 and the valve actuator pins 159 come into engagement with the valves 16 and 18. As shown in Fig. 54C, contact of the valve actuator pin with the ink outlet valve 18 causes the valve 18 to be depressed and close, thereby preventing further ink flow from the ink outlet 52 to the printhead assembly 22. In this regard, ink present in the passage from the closed ink outlet valve 18 to the printhead assembly 22 remains stationary until the ink outlet valve 18 opens.

As shown more clearly in Fig. 54D, when the valve actuator pin 159 contacts the ink inlet valve 16 and depresses the valve, the valve opens allowing a passage for the ink to flow from the refill unit 155 to the ink bag 46. Due to the back pressure present in the ink bag 46, the ink is drawn into the ink bag due to the pressure differential and as the ink bag 46 fills and expands with ink, the spring element 54 maintains a constant force between the ink bag 46 and the retainer element 55, thereby also maintaining a constant back pressure within the ink in the ink bag 46. This continues until the ink bag 46 reaches its maximum capacity whereby the pressure of the ink present in the ink bag 46 equalises with the pressure of the ink of the refill unit 155 and no more ink is drawn from the refill unit 155.

Bag constrictor actuators 190 extend through the apertures 60 to press the upper constrictor collar 59 towards the lower constrictor collar 57 to bow the side panels 58 inwards and constrict the bag 46. As discussed above with reference to Fig. 12, the bag constrictor 43, re-establishes the negative pressure in the ink bag 46 as the refill unit is removed, by releasing the constriction.

While the present invention has been illustrated and described with reference to exemplary embodiments thereof, various modifications will be apparent to and might readily be made by those skilled in the art without departing from the scope and spirit of the present invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth herein, but, rather, that the claims be broadly construed.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as, an acknowledgement or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

WHAT IS CLAIMED IS:-

1. A printhead for an inkjet printer, the printhead comprising:
a printhead integrated circuit having an array of ink ejection nozzles formed on a substrate;
a plurality of ink feed conduits for establishing fluid communication with at least one ink storage compartment; and,
a polymer sealing film between the ink feed conduits and the printhead integrated circuits, the polymer film having
an array of apertures such that the ejection nozzles are in fluid communication with the ink feed conduits; wherein, the polymer sealing film is more than 25 microns thick.

2. A printhead according to claim 1 wherein the array of apertures is an array of laser drilled holes in registration with respective ends of the ink feed conduits.

3. A printhead according to claim 1 wherein the polymer sealing film is a laminate with an adhesive layer on both sides of a thermoplastic film.

4. A printhead according to claim 1 wherein the thermoplastic film is a PET or polysulphone.

5. A printhead according to claim 1 wherein the ink feed conduits are formed in a liquid crystal polymer micro molding.

6. A printhead according to claim 1 incorporated in a cartridge unit for the inkjet printer, the cartridge unit comprising the ink storage compartment and an ink feed system for connection to the printhead,
wherein the ink storage compartment has a variable storage volume and a displaceable wall section biased to expand the variable storage volume to generate a negative pressure therein, such that ink does not inadvertently leak from the ink ejection nozzles.

7. A printhead according to claim 1 arranged to be supplied with ink by a negatively pressurized ink storage compartment, the ink storage compartment having an interface for receiving a refill unit for refilling the ink, the interface having an inlet valve biased to its closed configuration, wherein the refill unit comprises:
a body containing a quantity of ink;
engagement formations for releasably engaging the interface; and

an inlet valve actuator for opening the inlet valve as the refill unit engages the ink interface so that the ink in the body is in fluid communication with the ink storage compartment.

8. A printhead according to claim 1 incorporated in an ink cartridge having a negatively pressurized ink storage compartment that supplies ink to the printhead, and an interface for receiving a refill unit for refilling the ink, the interface having a normally closed inlet valve and a normally open outlet valve, both in fluid communication with the ink storage compartment, wherein the refill unit comprises:

a body containing a quantity of ink; and

a docking portion having an ink outlet and valve actuator formations, and

wherein during use, the docking portion releasably engages the interface to actuate the inlet and the outlet valves so the cartridge fills with ink from the body because of the negative pressure in the ink storage compartment.

9. A printhead according to claim 1 arranged to be supplied with ink by a negatively pressurized ink storage compartment which is arranged to be refilled by a refill unit via a normally open outlet valve, the refill unit comprising:

a body containing a quantity of ink;

engagement formations for releasably engaging the ink storage compartment; and

an outlet valve actuator for closing the outlet valve as the refill unit engages the ink storage compartment.

10. A printhead according to claim 1, wherein:

the ink storage compartment is arranged to be refilled by a refill unit;

during use, the ink storage compartment is maintained at a negative pressure to avoid inadvertent ink leakage from the nozzles;

the refill unit comprises a body containing a quantity of ink, an ink outlet and a repressurizing arrangement;

upon engagement of the refill unit with the ink storage compartment, the repressurizing arrangement causes part of the unit to be inwardly depressed as the ink from the body is drawn into the ink storage compartment through the ink outlet by the negative pressure until pressure equalization; and

upon subsequent disengagement of the refill unit from the ink storage compartment, the repressurizing arrangement releases the inwardly depressed part of the ink storage compartment to re-establish the negative pressure.

11. A printhead according to claim 1 incorporated in an ink cartridge for the inkjet printer, the cartridge comprising:

the ink storage compartment having opposed wall sections connected by a flexible wall arrangement to define a variable ink storage volume; and

an ink feed system for supplying for supplying ink to the printhead which has an array of nozzles,

wherein one of the opposed wall sections is displaceable and biased to expand the variable ink storage volume to create a negative pressure in the ink storage compartment for avoiding inadvertent ink leakage from the nozzles.

12. A printhead according to claim 1, wherein:

the ink storage compartment has an interface for releasably engaging with a refill unit for refilling the ink, the interface having valves for controlling ink flows into, and out of, the storage compartment; and

the refill unit comprises a body containing a quantity of ink, an ink outlet and valve actuators for actuating the valves when the refill unit engages the interface, such that the valve actuators actuate the valve in a predetermined sequence.

13. A printhead according to claim 1 incorporated in an ink cartridge that forms part of the inkjet printer, the printer having control circuitry and an interface for releasably engaging a refill unit for refilling the ink cartridge, wherein the refill unit comprises:

a body containing a quantity of ink;

an ink outlet; and

a memory circuit for storing information relating to at least one characteristic of the ink, and

wherein, during use, the memory circuit allows to the control circuit to interrogate it to verify that the ink in the refill unit is suitable for the printer.

14. A printhead according to claim 1, further comprising:

a nozzle plate with the array of nozzles formed therein; and

a printhead maintenance assembly comprising a capper to cover the array of nozzles when the printhead is not in use and a cleaner for engaging the nozzle plate and wiping across the nozzles,

wherein the cleaner is positioned between opposing sides of the capper.

15. A printhead according to claim 1, wherein the inkjet printer comprises:

a maintenance assembly for moving between a capped position where the assembly covers the array of nozzles, and an uncapped position spaced from the array of nozzles; and

a motorized drive for moving the maintenance assembly between the capped position and the uncapped position.

16. A printhead according to claim 1 incorporated in an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging an ink refill unit for replenishing the cartridge, wherein the ink refill unit comprises:

an ink storage compartment;

a docking portion for engaging the interface of the cartridge, the docking portion having a base plate with an ink outlet for connection to an inlet port on the interface; and

engagement formations for releasably engaging the interface, the engagement formations being formed on the transverse centre line of the base plate, the centre of the ink outlet being spaced from the transverse centre line.

17. A printhead according to claim 1 incorporated in an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging an ink refill for replenishing the cartridge, the ink storage compartment which is partially defined by a tubular flexible wall, and a constriction mechanism for constricting the flexible tubular wall by a predetermined amount, wherein the ink refill unit comprises:

a body containing a quantity of ink; and

a docking portion for engaging the interface of the cartridge, the docking portion having an ink outlet for connection to an inlet port on the interface, and a plurality of constriction actuators for actuating the constriction mechanism as the ink refill unit engages the interface and releases the constriction mechanism as the ink refill unit disengages the interface.

18. A printhead according to claim 1 incorporated in an ink cartridge in the inkjet printer, the ink cartridge having an interface for engaging an ink refill unit for replenishing the cartridge, wherein the ink refill unit comprises:

a body containing a quantity of ink;

an ink outlet for engaging a complementary ink inlet in the interface; and

a spigot extending from the body for insertion in an aperture in the interface, the lateral cross section of the spigot being keyed to the shape defined by the aperture to ensure the ink refill is correctly matched to the cartridge.

19. A printhead according to claim 1 incorporated in an ink cartridge in the inkjet printer, the ink cartridge being arranged to be replenished by an ink refill unit, the ink refill unit comprising:

a body containing ink;

an ink outlet for engaging a complementary ink inlet in the cartridge; and

a visual indicator to provide a visual indication when a predetermined quantity ink has flowed from the refill unit into the cartridge.

20. A printhead according to claim 1, wherein the inkjet printer comprises:

an outer casing with a hingedly mounted panel for access its interior; and

a cradle housed within the outer casing for supporting an ink cartridge, the cradle having a hingedly mounted lid that opens to allow the ink cartridge to be inserted and removed,

wherein the hinge axis of the lid and the hinge axis of the panel are parallel, and

wherein the lid and the panel both open in the same direction.