

PRINT MODULE HAVING PIVOTABLE PRINthead CARRIER

Field of the Invention

This invention relates to a pagewide print engines and print modules therefor. It has
5 been developed primarily for enabling printhead replacement in a print module without
requiring access to the print engine from above.

Background of the Invention

Inkjet printers employing Memjet® pagewide technology are commercially available
10 for a number of different printing applications, including desktop printers, digital inkjet
presses and wideformat printers. Memjet® printers typically comprise one or more stationary
inkjet printhead cartridges having a length of at least 200 mm, which are user-replaceable.
For example, a desktop label printer comprises a single user-replaceable multi-colored
printhead cartridge, a high-speed inkjet press comprises a plurality of user-replaceable
15 monochrome printhead cartridges aligned along a media feed direction, and a wideformat
printer comprises a plurality of user-replaceable printhead cartridges in a staggered
overlapping arrangement so as to span across a wideformat pagewidth.

US 2017/0313061 (the contents of which are incorporated herein by reference)
describes a commercial pagewide printing system comprising a two-dimensional array of
20 monochrome print modules.

US 2018/0222198 (the contents of which are incorporated herein by reference)
describes a full-color pagewide printhead having two rows of chips receiving ink from a
common manifold.

Digital multifunction printers (MFPs) employing pagewide inkjet technology are
25 increasingly viewed as a potential replacement for traditional laser MFPs. Digital inkjet
technology offers the advantages of high speed, low cost and high print quality. However, in
the same way that toner cartridges and fusers are consumables requiring periodic replacement
in laser MFPs, various components used in pagewide inkjet printing (*e.g.* printhead
cartridges, ink, service modules *etc.*) also need periodic replacement. In a typical enterprise
30 multifunction printer, user access to internal components is via one or more door panels
positioned at one side of the machine. Likewise, paper drawers are positioned at the same
side as the door panels. This allows the machine to be placed against a wall or in a corner of
an office, whilst still allowing access for paper-filling and servicing when required. In order
for digital inkjet MFPs to compete with traditional laser copiers, there is an expectation

among users that digital inkjet machines would maintain a similar form factor and service accessibility compared to their traditional laser counterparts.

Hitherto, digital inkjet print engines having replaceable pagewide printheads required access to the print module from an upper part of the print engine in order to replace the printhead. For example, the print modules described in US 2017/0313061 are lifted upwards from a support cradle for replacement of printhead cartridges.

It would therefore be desirable to provide a digital inkjet print engine employing pagewide technology, whereby replacement of a printhead cartridge can be achieved via side access only. From the foregoing, it will be appreciated that such a print engine will be suitable for use in a digital inkjet multifunction printer/copier as well as other types of pagewide printers requiring convenient replacement of printheads.

Summary of the Invention

In a first aspect, there is provided a print module comprising:

a cradle defining a longitudinal cavity and an access opening at a first end of the longitudinal cavity;
an elongate printhead carrier positioned in the longitudinal cavity, the printhead carrier being pivotable about a pivot axis at a second end of the cradle opposite the first end; and
an elongate printhead longitudinally slidably engaged with the printhead carrier,
wherein the printhead is removable from the cradle via pivoting of the printhead carrier and longitudinally sliding the printhead relative to the printhead carrier through the access opening.

Preferably, the printhead carrier comprises a rail and the printhead comprises an overhead hanger slidably engaged with the rail.

In some embodiments, a first end of the printhead carrier comprises a slidable latch for latching engagement with the first end of the cradle. Typically, the access opening has one or more retaining features for retaining a first end of the printhead carrier in a raised position.

Preferably, the pivot axis is transverse to the longitudinal axis.

Preferably, the print module further comprises a supply assembly slidably received in the cradle.

Preferably, the supply assembly comprises one or more of:

an ink coupling for connecting an ink supply to the printhead; and
a PCB for supplying data and/or power to the printhead.

Preferably, wherein the supply assembly comprises a thrust pin configured for urging a central portion of the printhead towards a lower nest portion of the cradle.

5 In some embodiments, a first end of the printhead carrier is connected to the supply assembly via a mechanical linkage. Typically, the cradle comprises a fixed limiter configured for abutment with a reaction plate of the printhead carrier so as to limit movement of the printhead carrier during pivoting movement thereof.

Preferably, the limiter comprises a tongue extending from the cradle towards the
10 printhead assembly, the tongue being configured for abutment with the reaction plate of the printhead carrier. Typically, the tongue passes through a tongue slot of the cradle during movement of the supply assembly.

Preferably, a guide positioned at the access opening, the guide having an upper surface configured for guiding the printhead into the longitudinal cavity without contacting
15 an ink ejection face of the printhead. Typically, the guide comprises a pair of support shoulders positioned for supporting longitudinal edge regions of the printhead and a recess between the support shoulders, the recess being aligned with the ink ejection face of the printhead.

Preferably, the printhead has a length of at least 200 mm.

20 In a second aspect, there is provided a print module comprising:

a cradle having a nest for receiving a printhead;

an elongate printhead assembly received in the nest, the printhead assembly comprising a printhead having first and second ink ports at opposite longitudinal ends thereof; and

25 a supply assembly slidably movable relative to the nest along an axis perpendicular to a longitudinal axis of the printhead, the supply assembly comprising first and second ink couplings fast with the supply assembly and connected to respective first and second ink ports,
wherein the print module is configured such that movement of the supply assembly
30 disconnects the second ink coupling prior to disconnection of the first ink coupling.

Preferably, the first and second ink couplings are positioned at opposite longitudinal ends of the printhead.

Preferably, the first end of the printhead assembly is operatively connected to the supply assembly.

Preferably, the second end of the printhead assembly is pivotally connected to the nest.

Preferably, raising of the supply assembly relative to the nest raises the first end of the printhead assembly relative to the second end.

5 Preferably, the printhead assembly is connected to the supply assembly via a hinged linkage.

Preferably, the first end of the cradle comprises a fixed tongue extending towards the printhead assembly, the tongue being configured for abutment with a reaction plate of the printhead assembly.

10 Preferably, abutment of the tongue with the reaction plate, during raising of the first end of the printhead, disconnects the first ink coupling from the printhead.

Preferably, the tongue passes through a tongue slot of the cradle during movement of the supply assembly.

15 Preferably, the print module comprises a lift mechanism for slidably moving the supply assembly relative to the nest.

Preferably, the supply assembly comprises a set of first ink couplings and a set of second ink couplings.

Preferably, each set of ink couplings is mounted on a respective ink coupling bracket.

20 Preferably, each ink coupling bracket comprises a plurality of locators for alignment with the printhead assembly.

Preferably, the locators comprise locating pins extending towards the printhead assembly.

In a third aspect, there is provided a print module comprising:

- 25 a cradle having a longitudinal cavity;
- an elongate printhead carrier positioned in the longitudinal cavity, the printhead carrier having a first end and a second end, the printhead carrier being pivotable relative to the cradle about a pivot axis the second end;
- a supply assembly slidably movable relative to the cradle along an axis perpendicular to a longitudinal axis of the printhead carrier, the supply assembly comprising
- 30 one or more ink couplings for fluidic connection to a printhead received in the printhead carrier; and
- a mechanical linkage interconnecting the first end of the printhead carrier and the supply assembly,

wherein reciprocal movement of the supply assembly moves the printhead carrier between a tilted position and a non-tilted position.

The print module according to the third aspect advantageously moves the printhead into a tilted position for longitudinal removal during linear movement of the supply assembly and decoupling of ink couplings. In this way, the user has to perform a minimal number of steps in order to remove and replace a printhead in the print module.

Preferably, the print module is configured for printhead removal and insertion in the tilted position.

Preferably, the print module is configured for printing in the non-tilted position.

Preferably, the printhead is datumed against a fixed lower nest of the cradle in the non-tilted position.

Preferably, the second end of the printhead carrier is pivotally mounted to the nest.

Preferably, the pivot axis is transverse to a longitudinal axis of the printhead.

Preferably, the supply assembly comprises first and second ink couplings positioned for coupling to first and second ink ports at opposite longitudinal ends of the printhead.

Preferably, the first ink coupling has sufficient coupling force with the first ink port so as to raise the first end of the printhead carrier during movement of the supply assembly.

Preferably, a fixed tongue of the cradle is positioned for abutment with a reaction plate of the printhead carrier, thereby decoupling the first ink coupling from the first ink port at a predetermined position.

Preferably, the mechanical linkage holds the printhead carrier in the tilted position subsequent to decoupling of the first ink coupling from the first ink port.

Preferably, the mechanical linkage extends with movement of the supply assembly subsequent to decoupling of the first ink coupling from the first ink port.

Preferably, the mechanical linkage is hinged.

Preferably, the tongue passes through a tongue slot of the cradle during movement of the supply assembly.

In a fourth aspect, there is provided a print module comprising:

- a cradle having a longitudinal cavity;
- an elongate printhead assembly positioned in the longitudinal cavity; and
- a supply assembly slidably movable relative to the cradle along an axis perpendicular to a longitudinal axis of the printhead assembly, the supply assembly comprising one or more ink couplings for fluidic connection to a printhead of the printhead assembly,

wherein the cradle comprises a fixed limiter configured for abutment with a reaction plate of the printhead assembly so as to limit movement of the printhead assembly during movement of the supply assembly away from the printhead assembly.

5 The print module according to the fourth aspect advantageously enables ink couplings at opposites ends of the printhead to be decoupled sequentially. This is advantageous because it minimizes the maximum decoupling force required compared to decoupling ink couplings simultaneously. Furthermore, when combined with a tilting motion of the printhead, the print module is conveniently configured for longitudinal printhead removal via movement of the supply assembly.

10 Preferably, the printhead assembly comprises a printhead carrier and the printhead.

Preferably, the limiter comprises a tongue extending from the cradle towards the printhead assembly, the tongue being configured for abutment with the reaction plate of the printhead assembly.

15 Preferably, the tongue passes through a tongue slot of the cradle during movement of the supply assembly.

Preferably, the printhead assembly is pivotally mounted to the cradle.

Preferably, a pivot axis of the printhead assembly is transverse to a longitudinal axis of the printhead.

20 Preferably, a first end of the printhead assembly is raised relative to a second end containing the pivot axis during movement of the supply assembly.

Preferably, abutment of the limiter with the reaction plate allows decoupling of a first ink coupling with a first ink port at the first end of the printhead during linear movement of the supply assembly.

25 Preferably, a hinged linkage between the supply assembly and the printhead assembly holds the printhead assembly subsequent to decoupling of the first ink couplings from the first ink ports.

Preferably, the hinged linkage extends with movement of the supply assembly subsequent to abutment of the limiter with the reaction plate.

30 It will of course be appreciated that preferred embodiments referring to one aspect are equally applicable to all relevant aspects.

More generally, there is provided a print engine comprising a print module as described herein. More generally, there is provided a printer (*e.g.* a multifunction printer having a side-access panel or door) comprising a print engine as described herein. Print

modules, print engines and printers, as described herein, are advantageously suitable for longitudinally loaded printheads.

As used herein, the term “print module” is taken to mean an assembly of components, which include a printhead (e.g. inkjet printhead) for printing. Typically, the print module is
5 itself a component of a print engine, which may comprise other components, such as maintenance components (e.g. capper, wiper etc.) and associated mechanisms for moving such components.

As used herein, the term “ink” is taken to mean any printing fluid, which may be printed from an inkjet printhead. The ink may or may not contain a colorant. Accordingly, the
10 term “ink” may include conventional dye-based or pigment based inks, infrared inks, fixatives (e.g. pre-coats and finishers), 3D printing fluids and the like.

As used herein, the term “mounted” includes both direct mounting and indirect mounting via an intervening part.

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Brief Description of the Drawings

Specific embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a printing device in the form of a digital inkjet MFP;

20 Figure 1A shows an internal print engine and ink delivery module of the digital inkjet MFP shown in Figure 1;

Figure 2 is a side perspective of the print engine;

Figure 3 is a bottom perspective of the print engine;

Figure 4 is a front perspective of the print engine;

25 Figure 5 shows a maintenance sub-assembly of the print engine;

Figure 6 is a front perspective view of a print module according to a first embodiment;

Figure 7 is a rear perspective of the print module according to the first embodiment;

Figure 8 is a perspective of an inkjet printhead;

30 Figure 9 is a perspective of a cradle for the print module according to the first embodiment;

Figure 10 is a top perspective of a supply assembly for the print module according to the first embodiment;

Figure 11 is an exploded perspective of the supply assembly shown in Figure 10 with PCBs removed;

Figure 12 is a sectional perspective of the supply assembly shown in Figure 10 with PCBs removed;

5 Figure 13 is shows a lever mechanism at a first end of the print module according to the first embodiment;

Figure 14 shows a sliding lock mechanism of the print module according to the first embodiment;

Figures 15A and 15B show a PCB clamp mechanism;

10 Figures 16A-C are schematic side views showing removal of a printhead from a pivoting printhead carrier;

Figure 17 is a magnified view of a first end of the print module according to the first embodiment;

15 Figure 18 is a magnified view of a second end of the print module according to the first embodiment;

Figure 19 is a perspective of the printhead carrier for the print module according to the first embodiment;

Figure 20 shows a latch mechanism for the printhead carrier shown in Figure 19 in a latched position;

20 Figure 21 shows the latch mechanism shown in Figure 20 with a guide plate removed;

Figure 22 shows the latch mechanism shown in Figure 20 in an unlatched position;

Figure 23A and 23B are schematic end views of the print module according to the first embodiment showing the latch in its lowered and raised positions;

Figure 24 is a front perspective of a print module according to a second embodiment;

25 Figure 25 is a rear perspective of the print module shown in Figure 24;

Figure 26 is a perspective of a cradle for the print module shown in Figure 24;

Figure 27 is a perspective of the cradle shown in Figure 26 with a scissor lift mechanism;

30 Figure 28 is a magnified view of a first end of the print module according to the second embodiment;

Figure 29 is a magnified view of a second end of the print module according to the second embodiment;

Figure 30 is perspective of a supply assembly for the print module according to the second embodiment;

Figure 31 is a magnified view of a first end of the supply assembly shown in Figure 30;

Figure 32 shows the first end of the print module according to the second embodiment with an actuator handle removed;

5 Figure 33 shows an actuator handle for the print module according to the second embodiment;

Figure 34 is a perspective of the print module according to the second embodiment after releasing a sliding lock mechanism;

10 Figure 35 is a magnified view of the first end of the print module shown in Figure 34 with the actuator handle removed

Figure 36 is a perspective of the print module according to the second embodiment after releasing raising the scissor lift mechanism;

Figure 37 is a magnified end perspective of the print module shown in Figure 36;

Figure 38 is a sectional view of the print module shown in Figure 36;

15 Figure 39 is a magnified sectional view of the first end of the print module shown in Figure 36; and

Figure 40 is a perspective of a printhead carrier according to the second embodiment.

Detailed Description of the Invention

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Print Engine

Referring to Figure 1, there is shown a printing device in the form of a digital inkjet multifunction printer 1 ("MFP"). The multifunction printer 1 comprises various standard features, such as a user interface 3, scanner 4 and output trays 5, as well as paper drawers 6
25 and a user-access panel 7 positioned at a same side as the paper drawers. The user-access panel 7 may be opened by users to allow side access to various internal components of the multifunction printer 1. Figure 1A shows an inkjet print engine 10 and an associated ink delivery module 12 accessible via the user-access panel 7. The print engine 10 is specifically configured for longitudinally side-loading of a printhead, as will be described in detail below.

30 Referring to Figures 2 to 4, the print engine 10 is shown in isolation. The print engine 10 comprises a chassis 15 for fixedly mounting to a frame (not shown) of the multifunction printer 1. A first print module 17 is movably connected to the chassis 15 via a module lift mechanism 19 for raising and lowering the print module relative to the chassis. The print

engine 10 is shown with the first print module 17 in its raised (maintenance) position in Figures 2 to 4 and with the print module in its lowered (printing) position in Figure 1A.

The module lift mechanism 19 takes the form of a rack-and-pinion mechanism comprising a pair of racks 21 mounted to opposite ends of a backplate 22 of the chassis 15 and a corresponding pair of pinions 23 engaged with the racks, the pair of pinions being
5 fixedly mounted about an interconnecting pinion shaft 25. The module lift mechanism 19 is driven by a lift motor 27 operatively connected to one of the pinions 23 for moving the pair of pinions along the racks via rotation of the interconnecting pinion shaft 25.

The pinion shaft 25 is rotatably mounted between a pair of lift brackets 29 housing
10 respective pinions 23, such that the lift brackets may be lowered or raised by the module lift mechanism 19. The lift brackets 29 are interconnected via an elongate mounting beam 31 extending longitudinally along a length of the print engine 10. An upper portion of the print module 17 has suitable mounting fixtures 30 for fixed attachment to the mounting beam 31 (see Figure 6). Hence, the first print module 17 may be raised and lowered via actuation of
15 the lift motor 27 between a maintenance position (Figures 2 to 4) and a printing position (Figure 1A), respectively. A spring mechanism (not shown) engaged with the lift brackets 29 may be used to assist in raising the first print module 17, while a bearing slider (not visible in Figures 2 to 4) attached to each lift bracket bears against one side of each rack 21 to counteract the moment of the print module.

20 A lower portion of the chassis 15 comprises an L-shaped frame 32 fixed to the backplate 22. The L-shaped frame 32 houses a maintenance sub-assembly 33 of the print engine 10 and is shown in isolation in Figure 5. The maintenance sub-assembly 33 comprises a printhead capper 35 and a wiper carriage 37 for performing maintenance operations on an elongate inkjet printhead 50 of the first print module 17. The printhead capper 35, which is
25 housed in a longer arm 39 of the L-shaped frame, is laterally extendible from the backplate 22 of the chassis 15 via a scissor mechanism 40 for capping the printhead. The wiper carriage 37, which is housed in a shorter arm 41 of the L-shaped frame, is traversable along a longitudinal axis of the first print module 17 for wiping the printhead. In the configuration shown in Figures 2 to 5, the capper 35 is in its laterally extended position with the printhead
30 capped, and the wiper carriage 37 is in its parked or 'home' position housed within the shorter arm 41 of the L-shaped frame 32. The maintenance sub-assembly 33 is similar in both function and mechanism to the maintenance module described in US 2017/0313061, the contents of which are incorporated herein by reference. Accordingly, for a more detailed

description of the function and mechanism of the maintenance sub-assembly 33, the skilled person is referred to US 2017/0313061.

Print Module (First Embodiment)

5 Referring to Figures 6 and 7, the first print module 17 according to a first embodiment is shown in isolation. The first print module 17 is generally elongate and serves the primary function of detachably mounting the printhead cartridge 50 (or “printhead 50”) shown in Figure 8. (The printhead cartridge 50 is described in detail in US 2018/0222198, the contents of which are incorporated herein by reference). The first print module 17 houses a pair of
10 opposed PCBs 52 and a pair of ink couplings 54, as well as various mechanisms for detachably connecting the PCBs and ink couplings to the printhead 50 and inserting/removing the printhead from the print module. In particular, the first print module 17 comprises a cradle 56 and a movable supply assembly 60.

Referring to Figure 9, the cradle 56 comprises a lower nest 57 defining a longitudinal
15 cavity 59 for receiving the printhead 50; front and rear cradle side plates 58 extending upwardly from the nest; and first and second end housings 78A and 78B fastened to the nest. Each of the first and second end housings 78A and 78B has a foot portion connected to anchor points 80 of the nest 57 and an upper portion containing the mounting fixtures 30 for attachment to the mounting beam 31 of the print engine 10. A resilient fastening arrangement
20 82 is used to attach the end housings 78A and 78B to the anchor points 80 in order to provide a degree of tolerance for the module lift mechanism 19 when datuming the print module 10 into its printing and maintenance positions.

The supply assembly 60 is slidably received in the cradle 56 between the front and rear cradle side plates 58, the supply assembly being liftable towards and away from the nest
25 57 (containing the printhead 50) by means of a lever mechanism 62 as will be described in more detail below.

Referring to Figures 10 to 12, the supply assembly 60 comprises a pair of front and rear PCB mounting plates 64 extending parallel with the cradle side plates 58. As shown in Figure 10, the opposed PCBs 52 are each fastened to a respective PCB mounting plate 64
30 with a space defined between the opposed PCBs. A fan assembly braced between the two PCB mounting plates 64 comprises a fan 70 and ducting arrangement 71 to provide airflow into the space between the PCBs 52 for cooling various electronic components. Structural rigidity is provided by first and second end brackets 68A and 68B interconnecting the front and rear PCB mounting plates 64.

Each of the first and second end brackets 68A and 68B has a mounting bracket 69 extending longitudinally outwardly therefrom for mounting a set of ink couplings 54 via a respective ink coupling bracket 72 hanging from the mounting bracket. Hence, the ink couplings 54 are fast with the supply assembly 60 and move in concert with the PCBs 52.

5 There are two sets of ink couplings 54 at opposite ends of the supply assembly 60 corresponding to inlet ports 74 and outlet ports 75 at opposite ends of the printhead 50.

The two sets of ink couplings 54, ink coupling brackets 72 and mounting shelves 69 positioned at opposite ends of the first print module 17 are contained in respective first and second end housings 78A and 78B of the cradle 56. The first end housing 78A at the first end
10 of the first print module 17 is shown transparent in Figures 6 and 7 to reveal the ink couplings 54 and associated mountings.

Referring now to Figures 7 and 13, movement of the supply assembly 60 relative to the cradle 56 is effected by means of a lever mechanism 62. The lever mechanism 62 comprises a pair of cam levers 84 engaged with respective spigots 86 projecting outwardly
15 from the first and second end brackets 68A and 68B. The cam levers 84 are fixedly mounted about a lever shaft 88 extending longitudinally along a rear face of the first print module 17 and supported by bushings 89 fixed to the rear PCB mounting plate 64. One end of the lever shaft 88 extends beyond the first end housing 78A and has a lever handle 90 for user actuation. Clockwise rotation (as shown in Figures 7 and 13) of the lever handle 90 and lever
20 shaft 88 actuates the lever mechanism 62 via camming engagement between the cam levers 84 and spigots 86, thereby causing downward movement of the supply assembly 60 towards the printhead 50. The ink couplings 54 are quick-connect couplings, which form fluidic connections to the printhead 50 once lowered into engagement with the printhead inlet ports 74 and outlet ports 75. Conversely anticlockwise rotation of the lever handle 90 raises the
25 supply assembly 60 and disengages the ink couplings 50 from the printhead inlet and outlet ports 74 and 75.

Referring to Figures 8 and 12, the supply assembly 60 comprises a pair of opposed thrust pins projecting transversely inwards from each of the PCB mounting plates 58. The thrust pins 76 are positioned for alignment with complementary notches 77 defined in a
30 central portion of the printhead 50. When the lever mechanism 62 is actuated to move the supply assembly 60 towards the printhead 50, the thrust pins 76 engage with the notches 77 to urge the printhead 50 downwards into seated (datumed) engagement with the nest 57. Thus, the elongate printhead 50 experiences a downward force at each end via the ink couplings 54 and in a middle portion via the thrust pins 76.

Referring to Figure 14, a sliding lock mechanism 92 is used to hold the supply assembly 60 in either its raised or lowered position. The lock mechanism 92 comprises first and second keepers 94 configured for locking engagement with transversely projecting locking pins 96 of the first and second end brackets 68A and 68B. The pair of keepers 94 are connected via a slide plate 98, which is longitudinally slidably movable by pushing on a lock handle 99 connected to the slide plate at the first end in order to disengage the keepers 94 from the locking pins 96 and allow movement of the supply assembly 60 using the lever mechanism 62. Once the supply assembly 60 has been lowered into position, pulling the lock handle 99 back towards the first end of the first print module 17 re-engages the respective keepers 94 and locking pins 96 so as to prevent movement of supply assembly and effectively disable the lever mechanism 62. As shown in Figure 14, the supply assembly 60 is in its raised position with the locking pins 96 disengaged from the keepers 94. In this raised position, the locking pin 96 at the first end is engaged with a holding feature 95 positioned above the first keeper 94. The holding feature 95 is connected to the slide plate 98 and serves the purpose of the holding the supply assembly 60 in its raised position during printhead removal and replacement.

As described above, ink connections to the printhead 50 are made by lowering the supply assembly 60 along a nominal z-axis using the lever handle 90 of the lever mechanism 62. With the supply assembly 60 in its lowered position, opposed rows of PCB contacts 101 are positioned adjacent respective printhead contacts 103 extending along opposite longitudinal sides of the printhead 50. However, electrical connections between the supply assembly 60 and the printhead 50 are formed in a separate step from the ink connections, thereby minimizing the forces required when replacing a printhead 50 from only one end of the print engine 10. Referring now to Figures 15A and 15B, a pair of clamp rods 105 are longitudinally rotatably mounted in the nest 57, each clamp rod extending parallel with a respective row of PCB contacts 101. The clamp rods 105 are each independently rotatable by means of a respective clamp lever 107 fixedly mounted to the clamp rods and positioned at the first end of the first print module 17. Each clamp rod 105 is configured for camming engagement with a respective resilient flange 108 extending from a lower part of each PCB mounting plate 58. Each resilient flange 108 is aligned with the PCB contacts 101 of a respective PCB 52 and, with the supply assembly 60 in its lowered positioned, each resilient flange is positioned between a respective clamp rod 105 and a respective row of printhead contacts 103. In the embodiment shown, each clamp rod 105 has a longitudinal cutout facing the printhead 50 when the clamp rod is in its unclamped position (Figure 13A) such that the

PCB contacts 101 are disengaged from the printhead contacts 103. Rotation of the clamp levers 107 towards each other clamps the PCB contacts 101 against the printhead contacts 103 along a nominal x-axis via the camming action of the clamp rods 105 against the resilient flanges 108. Figure 15A shows the clamp rods 105 in their unclamped positions and Figure 15B shows the clamp rods in their clamped positions. (The supply assembly 60 is shown in its raised position in Figure 15B, although it will be appreciated that clamping of the PCB contacts 101 against the printhead contacts 103 requires the supply assembly to be lowered).

The first end housing 78A at the first end of the first print module 17 defines an access opening 110 for longitudinal insertion and removal of the printhead 50 along a nominal y-axis. The printhead carrier 112 is pivoted about a pivot axis 116 transverse to the longitudinal axis of the first print module 17 at the second end thereof, such that one end of the printhead carrier proximate the access opening 110 at the first end of the print module can be lifted into a printhead access position.

Figures 16A-C show the basic pivoting motion of the printhead carrier 112 for removal of the printhead 50. In Figure 16A, the printhead is fully engaged with the printhead carrier and seated horizontally in the nest 57 in a printing configuration. In Figure 16B, the printhead 50 is still fully engaged with the printhead carrier 112, but the printhead carrier has been pivoted about the pivot axis 116 at the second end of the nest 57, such that the first end of the printhead carrier 112 (and printhead 50) is raised relative to the second end. In Figure 16C, the printhead 50 is being longitudinally slidably removed from the printhead carrier 112 by means of pulling the printhead away from the printhead carrier and through the access opening 110 of the cradle 56.

Figures 17 and 18 are magnified views of the first and second ends, respectively, of the first print module 17. In Figure 17, the overhead hanger 114 of the printhead 50 is engaged with the printhead carrier 112 and visible through the access opening 110. In Figure 18, a pair of trunnions 118 (only one trunnion visible in Figure 18) define the pivot axis 116 and provide pivoting engagement between a pivot bracket 122 of the printhead carrier 112 and the nest 57.

The printhead carrier 112, shown in isolation in Figure 19, comprises a latch bracket 120 at its first end and a pivot bracket 122 at its second end with a pair of spaced apart rails 126 extending therebetween. The rails 126 are configured for hanging the overhead hanger 114 of the printhead 50 when the printhead is slidably inserted into printhead carrier 112 from the first end. Referring briefly to Figure 8, the overhead hanger 114 is generally T-shaped comprising a pair of elongate flanges 128 extending transversely in opposite

directions from respective mounting bars 129 on an upper part of the printhead 50. Returning to Figure 19, the latch bracket 120 comprises an asymmetrical keying feature 130 in the form of a key notch for keying engagement with a complementary key projection 132 extending upwards from the printhead 50. The keying feature 130 and complementary key projection 132 ensure that the printhead 50 can only be slidably inserted into the printhead carrier 112 in a correct orientation.

Referring to Figures 20 to 22, a latch 134 is slidably connected to the latch bracket 120 for either latching or releasing the printhead carrier 112, thereby either latching the printhead 50 in its printing position or allowing pivoting movement of the printhead carrier 112 for removal of the printhead. The latch 134 is engaged in a pair of slots of the latch bracket 120 for sliding movement along a longitudinal axis of the first print module 17. The latch 134 comprises a latch handle 136 for user actuation and a pair of tabs 138 for latching engagement with complementary latch slots 140 defined in a guide plate 142 at the first end of the nest 57 (as well as a nest endplate 144). Figure 20 shows the latch 134 in its latched configuration with the tabs 138 engaged in the latch slots 140 of the guide plate 142. In Figure 21, the guide plate 142 and nest endplate 144 have been removed to reveal the sliding mechanism 143 of the latch relative to the latch bracket 120 as well as the tabs 138. Figure 22 shows the latch 134 in its unlatched position with the latch handle 136 pushed inwards and the tabs 138 disengaged from the latch slots 140. In this unlatched configuration, the printhead carrier 112 is free to pivot about the pivot axis 116 such that the first end of the printhead 50 can be raised into alignment with the access opening, thereby enabling sliding longitudinal removal of the printhead from the print module (Figures 16B and 16C).

The guide plate 142 is formed of a suitable material (*e.g.* plastics) to allow the printhead to slide freely along its upper surface during insertion or removal of the printhead. Further, as best seen in Figure 20, an upper guide surface 148 of the guide plate 142 is profiled such that the printhead 50 can be removed from the first print module 17 without its ink ejection face being damaged. Specifically, the guide surface 148 has a central recess 150 positioned between a pair of support shoulders 152. The support shoulders 152 contact lower longitudinal edge regions of the printhead 50 while the recess 150 is spaced apart from an ink ejection face of the printhead (containing sensitive printhead chips), thereby minimizing any potentially damaging contact between the first print module 17 and the ink ejection face during longitudinal removal or insertion of the printhead.

In order to remove the printhead 50 from the first print module 17, a user facing the first end of the print module performs the following sequence of steps. First, the clamp levers

107 are rotated in opposite directions to unclamp the PCB contacts 101 from the printhead contacts 103. Next, the lock handle 99 is pushed inwards in order to release the lever mechanism 62. With the lever mechanism released, the lever handle 90 is rotated anticlockwise to disengage the ink couplings 54 from the printhead 50 and raise the supply assembly 60 away from the printhead. Next, the latch handle 138 is pushed inwards to unlatch the printhead carrier 112 and, still holding the latch handle, the printhead carrier 112 is pivoted upwards so that the printhead 50 aligns with the access opening 110 of the cradle 56. (As best shown in Figures 23A and 23B, the latch 134 has opposite winglets 155 configured for supporting the printhead carrier 112 via engagement with retaining notches 157 defined in the access opening 110 when the latch is raised). With the first end of the printhead carrier 112 raised and retained by the retaining notches 157, the printhead 50 can then be removed from the first print module 17 by longitudinally sliding the printhead relative to the printhead carrier 112 and out through the access opening 110. The reverse sequence of steps is used to insert a replacement printhead 50 into the first print module 17.

It will be appreciated that all steps in the sequence described above may be performed by a user who may have access to only one end of the print engine 10. Therefore, the print engine 10 is suitable for use in a multifunction printer of the type described above having a user-access panel positioned in one side of the printer.

Second Print Module (Second Embodiment)

Referring to Figures 24 and 25, a second print module 200 according to a second embodiment is shown in isolation. The second print module 200 has the same form factor as the first print module 17 and, likewise, serves the primary function of detachably mounting the printhead cartridge 50 (or “printhead 50”) shown in Figure 8. Where relevant, like reference numerals will be used to describe the same or similar features having like functions in the first print module 17 and the second print module 200.

The second print module 200 is designed for fixed attachment to the mounting beam 31 of the print engine 10 (see Figure 2) and to that end comprises corresponding mounting fixtures 30 at an upper part thereof. In common with the first print module 17, the second print module 200 houses a pair of opposed PCBs 52 and a pair of ink couplings 54 for detachably connecting the PCBs and ink couplings to the printhead 50, thereby enabling printhead insertion/removal. Furthermore, the second print module 200 comprises a cradle 56 and a movable supply assembly 60 in order to effect such ink and electrical connections.

However, the second print module 200 comprises an alternative scissor lift mechanism 202 for moving the supply assembly 60 relative to the cradle 56, as will be described in more detail below. Furthermore, actuation of the scissor lift mechanism 202, the sliding lock mechanism 92 and PCB clamp mechanism is controlled by a single multifunctional actuator handle 203, as opposed to the various handles and levers described above in connection with the first embodiment. Nevertheless, pivoting motion of the printhead carrier 112, with sliding longitudinal movement of the printhead 50 (via the overhead hanger 114) relative to the carrier, for printhead insertion/removal (see Figures 16A-C) remains a common feature of the mechanisms used in both the first print module 17 and the second print module 200.

Referring to Figure 26, the cradle 56 according to the second embodiment comprises the lower nest 57 defining the longitudinal cavity 59 for receiving the printhead 50; front and rear cradle side plates 58 extending upwardly from the nest; and first and second end housings 78A and 78B fastened to the nest. Each of the first and second end housings 78A and 78B has a foot portion connected to anchor points 80 of the nest 57 and an upper portion having the mounting fixtures 30 for attachment to the mounting beam 31 of the print engine 10. A resilient fastening arrangement 82 is used to attach the end housings 78A and 78B to the anchor points 80 in order to provide a degree of tolerance for the module lift mechanism 19 when datuming the print module 10 into its printing and maintenance positions. In addition, the cradle 56 according to the second embodiment comprises a pair of support brackets 204 fastened between the opposed cradle side plates 58 for supporting the scissor lift mechanism 202. Figures 27 to 29 show the cradle 56 according to the second embodiment with the sliding lock mechanism 92, scissor lift mechanism 202 and actuator handle 203. Operations of the sliding lock mechanism 92 and scissor lift mechanism 202 are described in more detail below.

The supply assembly 60 according to the second embodiment is shown in isolation in Figures 30 and 31. Similar to the first embodiment, the supply assembly 60 according to the second embodiment is slidably received in the cradle 56 between the front and rear cradle side plates 58 and is liftable towards and away from the nest 57.

Similar to the first embodiment, the supply assembly 60 according to the second embodiment also comprises a pair of front and rear PCB mounting plates 64 extending parallel with the cradle side plates 58, each PCB mounting plate having a respective resilient flange 108 at a lower part thereof. The opposed PCBs 52 are each fastened to a respective PCB mounting plate 64 with a space defined between the opposed PCBs. The fan assembly

is, likewise, braced between the two PCB mounting plates 64 with the fan 70 and ducting arrangement 71 (not visible in Figures 30 and 31) providing airflow into the space between the PCBs 52 for cooling various electronic components (see Figures 10 and 11). Structural rigidity is provided by the first and second end brackets 68A and 68B interconnecting the front and rear PCB mounting plates 64. (The front and rear mounting plates 64 together with the first and second end brackets 68A and 68B are collectively a “supply assembly housing”).

The first and second end brackets 68A and 68B each have a respective mounting bracket 69 extending longitudinally outwardly therefrom for mounting sets of ink couplings 54 via a respective ink coupling bracket 72 hanging from the mounting bracket. Hence, in the same manner as the first embodiment, the ink couplings 54 are fast with the supply assembly 60 and move in concert with the PCBs 52. Locating pins 205 extending downwardly from the ink coupling bracket 72 are configured to align the ink couplings 54 with corresponding printhead inlet and outlet ports 74 and 75 during engagement of the supply assembly 60 with the printhead 50.

Additionally, each mounting bracket 69 of the supply assembly 60 according to second embodiment comprises a respective sleeve 208 for receiving a lift rod 210 of the scissor lift mechanism 202. The sleeves 208 at each end of the supply assembly 60 therefore provide a means by which the supply assembly may be lifted (and lowered) relative to the cradle 56. The locking pins 96 for locking the scissor lift mechanism 202 project outwardly from either side of each mounting bracket 96.

Features of the scissor lift mechanism 202 and sliding lock mechanism 92 in the print module 200 according to the second embodiment will now be described with reference to a printhead removal operation. Initially, as shown in Figures 24 and 25, the sliding lock mechanism 92 is locked with the printhead 50 fully inserted in the print module 200 in a printing configuration. In the printing configuration, all ink couplings 54 are fluidically connected to the printhead 50, the PCB contacts 101 are electrically connected to the printhead contacts 103, and the printhead 50 is datumed against the nest 57.

Figure 32 shows the print module 200 with the actuator handle 203 and nest 57 removed to reveal details of both the sliding lock mechanism 92 and PCB clamp mechanism 93. The sliding lock mechanism 92 comprises a pair of slide plates 98, each having a keeper 94 engaged with a corresponding locking pin 96 projecting laterally outwards from each mounting bracket 69 of the supply assembly 60. Each slide plate 98 further comprises a respective slide actuator 212 fast with the slide plate 98 for engagement with the actuator handle 203. A slide plate pin 214 of the actuator handle 203 is engaged with a

complementary notch feature 216 of the slide actuator 212 in order to effect longitudinal sliding movement of the slide plate 98. Thus, a user pulling on the handle 203 longitudinally slides the slide plate 98 towards the user and releases the keepers 94 from engagement with the locking pins 96, thereby releasing the supply assembly 60 from its locked position.

5 As well as releasing the supply assembly 60 from its locked position, longitudinal sliding movement of the slide plate 98 simultaneously unclamps the PCB contacts 101 from the printhead contacts 103. Referring to Figures 32 and 35, each slide plate 98 has a plurality of clamps 218 projecting inwardly from a lower clamp portion 219 thereof. Each clamp 218 is engaged with a corresponding cam projection 220 of an adjacent resilient flange 108 by
10 virtue of clamp slots 222 defined in sidewalls of the nest 57 (see Figure 26). In the locked position shown in Figure 32, the clamps 218 urge each resilient flange 108 inwards so as to urge the PCB contacts 101 into engagement with the printhead contacts 103. After longitudinal sliding movement of the slide plate 98, as shown in Figure 35, the clamps 218 release the resilient flanges 108 outwards by virtue of the spring bias of the resilient flanges
15 and the sloping profile of the cam projections 220, thereby disengaging the PCB contacts 101 from the printhead contacts 103. Hence, the slide plate 98, which is longitudinally slidable by pulling on the actuator handle 203, performs the dual functions of releasing the sliding lock mechanism 92 whilst simultaneously releasing the opposed resilient flanges 108 and PCB contacts 101 from an engaged (electrically connected) to a disengaged (electrically
20 disconnected) position.

The actuator handle 203 is not only engaged with the slide plate 98 via the slide plate pins 214 and slide actuator 212, but is also engaged with the scissor lift mechanism 202 for the purpose of lifting and lowering the supply assembly 60, as will now be described. Referring initially to Figure 27, the scissor lift mechanism 202 comprises a pair of first and
25 second scissor arms 224 and 226 at each side of the print module 200. Each first scissor arm 224 has an upper end pivotally connected to one of the support brackets 204 and a lower end portion connected to the actuator handle 203 via scissor pins 228 of the actuator handle, which are slidably received in a corresponding handle slot 230 defined in the lower end portion of the first scissor arm (see Figures 32 and 33). Hence, each of the first scissors arms
30 224 is configured, by virtue of the slidable scissors pins 228 received in the handle slot 230, to allow sliding movement of the actuator handle 203 for release of the sliding lock mechanism 92, as described above. Returning to Figure 27, the second scissor arm 226 has an upper end pivotally connected to an opposite support bracket 204 and a midpart pivotally engaged with the first scissor arm to define a scissor axis 232. The parallel pair of first scissor

arms 224 are interconnected via a respective lift rod 210 at their lower ends for lifting the supply assembly 60. Likewise, the parallel pair of second scissor arms are interconnected at their lower ends via a respective lift rod 210 (see Figures 28 and 29). Each lift rod 210 is received in the sleeve 208 of a corresponding mounting bracket 69 such that motion of the scissor lift mechanism 202 is transferred to linear motion of the supply assembly 60 via the lift rods 210 engaged with their respective sleeves 208.

Figure 36 shows the print module 200 with the scissor lift mechanism (and supply assembly 60) in its raised position for printhead removal. Thus, in order to raise the supply assembly 60, the user simply grasps the actuator handle 203, pulls it towards him to release the sliding lock mechanism 92 and PCB clamp mechanism 93, as described above, and then raises the actuator handle upwards to actuate the scissor lift mechanism 202. The scissor lift mechanism 202 may be latched in the raised position via engagement between the slide plate pins 214 of the actuator handle 203 and corresponding catches 238 fixed to the first end housing 78A (see Figure 37). This enables the user to have two free hands in order to pull the printhead 50 longitudinally from the print module 200.

The printhead 50 is slidably received in the printhead carrier 112 via its overhead hanger 114. However, in contrast with the print module 17 according to the first embodiment, the printhead carrier 112 in the second embodiment is connected to the supply assembly 60 via a pair of hinged linkages 240, as best seen in Figures 38 and 39. Each hinged linkage 240 has a lower end pivotally connected to the printhead carrier 112 and an upper end pivotally connected to the mounting bracket 69 via the locking pin 96. Hence, upward movement of the supply assembly 60 raises the first end of the printhead carrier 112 via a holding force of the ink couplings 54 at the first end and the hinged linkage 240, whilst the opposite second end of the printhead carrier is pivotally connected to the nest 57, thereby tilting the printhead carrier upwards at the first end for printhead removal as described in connection with schematic Figures 16A-C.

With initial upwards movement of the supply assembly 60, the ink couplings 54 at the second end 20 of the print module 200 disconnect from the printhead 50. However, the ink couplings 54 at the first end 18 of the print module 200 do not disconnect simultaneously with the ink couplings at the second end as result of the initial upward movement of the printhead 50 and printhead carrier 112. In order to achieve fluid disconnection at the first end of the printhead 50, a fixed tongue 242 depends downwardly from the first end housing 78A for engagement with the printhead carrier 112. During upward movement of the supply assembly 60, the tongue 242 passes through a tongue slot 244 of the mounting bracket 69 and

butts against a reaction plate 246 at the first end of the printhead carrier 112. The tongue 242, therefore, limits upward movement of the printhead carrier 112 and allows the ink couplings 54 at the first end to be pulled away from and disconnect from the printhead 50. Meanwhile, the hinged linkage 240 extends further and continues to support the printhead carrier 112 as the support assembly 60 moves upwards for fluidic disconnection. Advantageously, the ink couplings 54 at the first end 18 and second end 20 are disconnected separately, which reduces the force requirements for disconnection compared to the first embodiment whereby the two sets of ink couplings are disconnected simultaneously.

In Figure 39, the hinged linkage is shown extended with the tongue butting the reaction plate 246 of the printhead carrier 112 and the ink couplings 54 at both ends of the printhead 50 disconnected. In this configuration, the printhead 50 is ready to be slidingly removed from the printhead carrier by the user and replaced. For printhead replacement, the user performs reverse sequence of steps to those described above: the replacement printhead 50 is initially longitudinally slid into the printhead carrier 112; the user grasps the actuator handle 203 and unlatches it from the catch 238; the user then moves the actuator handle 203 downwards to actuate the scissor lift mechanism 202 and move the supply assembly 60 downwards – this movement makes fluidic connections between the ink couplings 54 and inlet/outlet ports at both ends of the printhead 50 and also datums the printhead into the nest 57; finally, the user pushes the actuator handle 203 inwards (i.e. away from the user) to actuate the PCB clamp mechanism 93 and form electrical connections, as well as actuate the sliding lock mechanism 92 to lock the supply assembly 60 in the printing position.

It will, of course, be appreciated that the present invention has been described by way of example only and that modifications of detail may be made within the scope of the invention, which is defined in the accompanying claims.

CLAIMS

1. A print module comprising:
 - a cradle defining a longitudinal cavity and an access opening at a first end of
 - 5 the longitudinal cavity;
 - an elongate printhead carrier positioned in the longitudinal cavity, the printhead carrier being pivotable about a pivot axis at a second end of the cradle opposite the first end; and
 - an elongate printhead longitudinally slidably engaged with the printhead
 - 10 carrier,
 - wherein the printhead is removable from the cradle via pivoting of the printhead carrier and longitudinally sliding the printhead relative to the printhead carrier through the access opening.
- 15 2. The print module of claim 1, wherein the printhead carrier comprises a rail and the printhead comprises an overhead hanger slidably engaged with the rail.
3. The print module of claim 1, wherein a first end of the printhead carrier comprises a slidable latch for latching engagement with the first end of the cradle.
- 20 4. The printhead module of claim 1, wherein the access opening has one or more retaining features for retaining a first end of the printhead carrier in a raised position.
5. The print module of claim 1, wherein the pivot axis is transverse to the longitudinal
- 25 axis.
6. The print module of claim 1 further comprising a supply assembly slidably received in the cradle.
- 30 7. The print module of claim 6, wherein the supply assembly comprises one or more of:
 - an ink coupling for connecting an ink supply to the printhead; and
 - a PCB for supplying data and/or power to the printhead.

8. The print module of claim 6, wherein the supply assembly comprises a thrust pin configured for urging a central portion of the printhead towards a lower nest portion of the cradle.

5 9. The print module of claim 6, wherein a first end of the printhead carrier is connected to the supply assembly via a mechanical linkage.

10. The print module of claim 9, wherein the cradle comprises a fixed limiter configured for abutment with a reaction plate of the printhead carrier so as to limit movement of the
10 printhead carrier during pivoting movement thereof.

11. The print module of claim 10, wherein the limiter comprises a tongue extending from the cradle towards the printhead assembly, the tongue being configured for abutment with the reaction plate of the printhead carrier.

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12. The print module of claim 11, wherein the tongue passes through a tongue slot of the cradle during movement of the supply assembly.

13. The print module of claim 1 comprising a guide positioned at the access opening, the guide having an upper surface configured for guiding the printhead into the longitudinal cavity without contacting an ink ejection face of the printhead.
20

14. The print module of claim 13, wherein the guide comprises a pair of support shoulders positioned for supporting longitudinal edge regions of the printhead and a recess between the support shoulders, the recess being aligned with the ink ejection face of the printhead.
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15. The print module of claim 1, wherein the printhead has a length of at least 200 mm.

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