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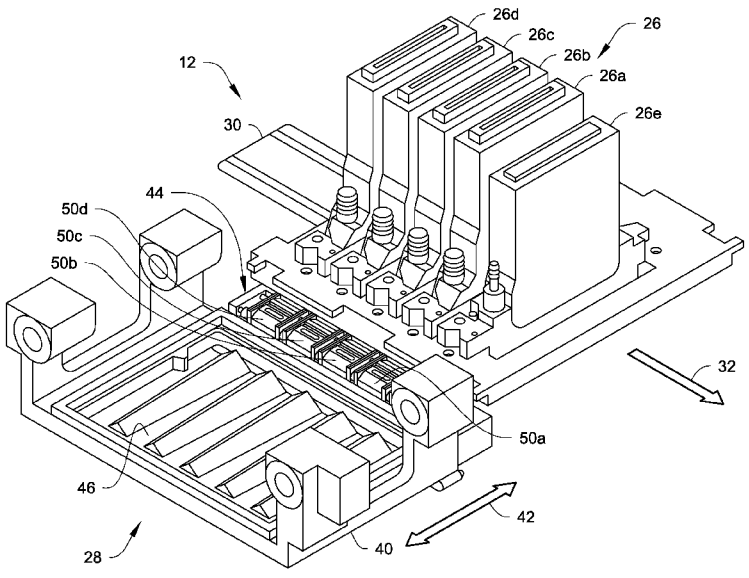
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(54) Title: DROP-ON-DEMAND PRINT HEAD CLEANING MECHANISM AND METHOD

Fig. 2



(57) Abstract: A card processing system includes a drop-on-demand card printing system that has at least one drop-on-demand print head with a nozzle plate. An automated cleaning mechanism is provided in the drop-on-demand card printing system that is configured to clean the nozzle plate without the cleaning mechanism physically contacting the nozzle plate. Since the nozzle plate is not physically contacted by the cleaning mechanism, damage to the nozzle plate during cleaning is avoided thereby avoiding degrading the resulting print quality of the print head.

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DROP-ON-DEMAND PRINT HEAD CLEANING MECHANISM AND METHOD

Field

[0001] This disclosure relates to card processing systems that process plastic cards including, but not limited to, financial (e.g., credit, debit, or the like) cards, driver's licenses, national identification cards, business identification cards, gift cards, and other plastic cards, and to transporting cards in such card processing systems.

Background

[0002] In drop-on-demand printing, partially cured ink and other debris can accumulate on the print head nozzle plate (the surface of the print head that has a series of openings through which ink passes) and adversely affect the ink's flow and therefore the print quality. Regular cleaning of the nozzle plate is therefore often conducted. Many of the known techniques for cleaning the nozzle plate involve direct contact between the nozzle plate and a cleaning element such as a cloth or a brush. However, the nozzle plate surface is very delicate and can be easily damaged by excess pressure or abrasion. As a result, cleaning processes that directly contact the nozzle plate risks damaging the nozzle plate and thereby degrading the resulting print quality of the print head.

Summary

[0003] Systems and methods are described where a card processing system includes a drop-on-demand card printing system that has at least one drop-on-demand print head with a nozzle plate. An automated cleaning mechanism is provided in the drop-on-demand card printing system that is configured to clean the nozzle plate without the cleaning mechanism physically contacting the nozzle plate. Since the nozzle plate is not physically contacted by the cleaning mechanism, damage to the nozzle plate during cleaning is avoided thereby avoiding degrading the resulting print quality of the print head.

[0004] The cards to be processed as described herein include, but are not limited to, plastic cards which bear personalized data unique to the intended cardholder and/or which bear other card information. Examples of plastic cards can include, but are not limited to, financial (e.g.,

credit, debit, or the like) cards, driver's licenses, national identification cards, business identification cards, gift cards, and other plastic cards.

[0005] The drop-on-demand card printing system can print using any suitable ink used in drop-on-demand printing and that is suitable for use on the types of cards described herein. For example, the ink can be an ultraviolet (UV) curable ink.

[0006] The drop-on-demand card printing system can have a single print head or a plurality of print heads. The drop-on-demand card printing system can perform monochromatic or multi-color printing. In one example of multi-color printing, five print heads, each of which has a nozzle plate, can be provided. Each print head can be designated to print a specific color ink, such as cyan, magenta, yellow, black and white (CMYKW).

[0007] The card processing system described herein can be any card processing system that can process cards such as by printing on the cards using the drop-on-demand card printing system, in combination with one or more of: reading data from and/or writing data to a magnetic stripe on the cards, programming an integrated circuit chip on the cards, emboss characters on the cards, indenting characters on the cards, laminating the cards, using a laser that performs laser processing such as laser marking on the cards, applying a topcoat to a portion of or the entire surface of the cards, checking the quality of personalization/processing applied to the cards, applying a security feature such as a holographic foil patch to the cards, and other card processing operations.

[0008] One card processing system can include a card input that is configured to hold a plurality of cards to be processed and a card output that is configured to hold a plurality of processed cards. At least one of a magnetic stripe reading/writing system and an integrated circuit chip programming system is downstream of the card input and between the card input and the card output. In addition, a drop-on-demand card printing system is downstream of the card input, for example between the card input and the card output, which is configured to print on a card using UV curable ink. The drop-on-demand card printing system includes at least one drop-on-demand print head having a nozzle plate. The drop-on-demand card printing system further

includes a cleaning mechanism that is configured to clean the nozzle plate of the at least one drop-on-demand print head without the cleaning mechanism physically contacting the nozzle plate. The card processing system also includes an UV curing station downstream from the card input, for example between the card input and the card output or between the printing system and the card output, where the UV curing station is configured to cure UV curable ink applied to a card by the drop-on-demand card printing system.

[0009] Another card processing system can include a card input that is configured to hold a plurality of cards to be processed, a card output that is configured to hold a plurality of processed cards, at least one of a magnetic stripe reading/writing system and an integrated circuit chip programming system downstream of the card input, a drop-on-demand card printing system downstream of the card input that is configured to print on a card, where the drop-on-demand card printing system includes at least one drop-on-demand print head having a nozzle plate. The drop-on-demand card printing system further includes a cleaning mechanism that is configured to clean the nozzle plate of the at least one drop-on-demand print head without the cleaning mechanism physically contacting the nozzle plate.

[0010] Still another card processing system can include a card input that is configured to hold a plurality of cards to be processed, a card output that is configured to hold a plurality of processed cards, and a drop-on-demand card printing system downstream from the card input. The drop-on-demand card printing system is configured to print on a card using ultraviolet curable ink, and the drop-on-demand card printing system includes at least one drop-on-demand print head having a nozzle plate. In addition, the drop-on-demand card printing system further includes a cleaning mechanism that is configured to clean the nozzle plate of the at least one drop-on-demand print head without the cleaning mechanism physically contacting the nozzle plate. An ultraviolet curing station is downstream from the card input, for example downstream from the drop-on-demand card printing system, where the ultraviolet curing station is configured to cure ultraviolet curable ink applied to a card by the drop-on-demand card printing system.

[0011] A cleaning mechanism and cleaning method for cleaning the nozzle plate(s) of the drop-on-demand print head(s) are also described. The cleaning mechanism and method clean the

nozzle plate without a physical structure such as a cleaning element directly contacting the nozzle plate. Instead, a cleaning fluid is applied to the surface of the nozzle plate without a physical structure directly contacting the nozzle plate. Thereafter, a vacuum is used to remove the cleaning fluid and any loosened ink and other debris from the surface of the nozzle plate. In the described cleaning mechanism and method, a portion of the cleaning mechanism may contact a portion(s) of the print head other than the nozzle plate. However, there is no direct physical contact between the cleaning mechanism and the nozzle plate.

Drawings

[0012] Figure 1 illustrates a card processing system described herein.

[0013] Figure 2 illustrates select components of a drop-on-demand card printing system of the card processing system of Figure 1.

[0014] Figure 3 is a close-up view of the cleaning blocks of the cleaning mechanism of the drop-on-demand card printing system.

[0015] Figure 4 is a detailed view of one of the cleaning blocks.

[0016] Figure 5 illustrates a positional relationship between one of the cleaning blocks and one of the print heads during cleaning.

[0017] Figure 6A illustrates the movement of the cleaning mechanism during application of a cleaning fluid to the nozzle plates of the print heads.

[0018] Figure 6B illustrates the movement of the cleaning mechanism during removal of the cleaning fluid from the nozzle plates of the print heads.

[0019] Figure 7 is a schematic diagram of the cleaning solution system and the vacuum system of the cleaning mechanism.

[0020] Figure 8 illustrates another embodiment of the cleaning blocks described herein.

Detailed Description

[0021] Figure 1 illustrates an example of a card processing system 10 described herein. The system 10 is configured to process cards by at least printing on the cards using a drop-on-demand (DOD) card printing system 12 included in the system 10. The system 10 can also include at least one other card processing capability in addition to the printing by the DOD card printing system 12. For example, the additional card processing can include a magnetic stripe read/write system 14 that is configured to read data from and/or write data to a magnetic stripe on the cards, and/or an integrated circuit chip programming system 16 that is configured to program an integrated circuit chip on the cards. When the DOD card printing system 12 prints using ultraviolet (UV) curable ink, a UV cure station 18 can also be provided. The construction and operation of the systems 14, 16, 18 is well known in the art. Magnetic stripe read/write systems and integrated circuit chip programming systems are disclosed, for example, in U.S. Patent 6902107 and U.S. Patent 6695205, and can be found in the MX family of central issuance systems available from Entrust Datacard Corporation of Shakopee, Minnesota. An example of a UV radiation applicator in a card printing system is the Persomaster card personalization system available from Atlantic Zeiser GmbH of Emmingen, Germany.

[0022] The cards to be processed as described herein include, but are not limited to, plastic cards which bear personalized data unique to the intended cardholder and/or which bear other card information. Examples of plastic cards can include, but are not limited to, financial (e.g., credit, debit, or the like) cards, driver's licenses, national identification cards, business identification cards, gift cards, and other plastic cards.

[0023] In the system 10 illustrated in Figure 1, a card input 20 is provided that is configured to hold a plurality of cards waiting to be processed. Cards are fed one-by-one from the card input 20 into the rest of the system 10 where each card is individually processed. Processed cards are transported into a card output 22 that is configured to hold a plurality of the processed cards.

[0024] The card processing system 10 illustrated in Figure 1 is a type of system that can be referred to as a central issuance card processing system. In a central issuance card processing system, the card input 20 and the card output 22 are generally at opposite ends of the system with the card processing mechanisms, such as the systems 12, 14, 16, 18 in Figure 1, between the card input 20 and the card output 22. A central issuance card processing system is typically designed for large volume batch processing of cards, often employing multiple processing stations or modules to process multiple cards at the same time to reduce the overall per card processing time. Examples of central issuance card processing systems include the MX family of central issuance systems available from Entrust Datacard Corporation of Shakopee, Minnesota. Other examples of central issuance systems are disclosed in U.S. Patents 4,825,054, 5,266,781, 6,783,067, and 6,902,107, all of which are incorporated herein by reference in their entirety. In one example, the card processing system 10 can process cards at a rate of at least about 500 cards per hour, or at least about 1000 cards per hour, or at least about 1500 cards per hour, or at least about 2000 cards per hour, or at least about 2500 cards per hour.

[0025] In Figure 1, the systems 12, 14, 16, 18 are downstream of the card input 20 and between the card input 20 and the card output 22. The sequence or arrangement of the systems 12, 14, 16, 18 relative to one another and relative to the card input 20 can be varied from the sequence that is illustrated in Figure 1.

[0026] The system 10 may include additional card processing systems not illustrated in Figure 1, which are well known in the art of card processing and which may also be located between the card input 20 and the card output 22. For example, the system 10 may include a card embossing system that is configured to emboss characters on the cards; an indenting system that is configured to indent characters on the cards; a laminator system that is configured to apply a laminate to the cards; a laser system that uses a laser to perform laser processing such as laser marking on the cards; a topcoat station that is configured to apply a topcoat to a portion of or the entire surface of the cards; a quality control station that is configured to check the quality of personalization/processing applied to the cards; a security station that is configured to apply a security feature such as a holographic foil patch to the cards; and other card processing

operations. The additional card processing systems may be located anywhere in the system 10, such as between the UV cure station 18 and the card output 22.

[0027] Figure 2 illustrates select components of the drop-on-demand card printing system 12. The system 12 includes at least one DOD print head 26 and an automated cleaning mechanism 28 that is configured to clean a nozzle plate of the DOD print head 26. The printing performed by the drop-on-demand card printing system 12 can be monochromatic or multi-color. Figure 2 shows five DOD print heads 26a-e arranged side-by-side to sequentially print onto a surface of a card 30 as the card 30 is transported past the print heads 26a-e, for example underneath the print heads 26a-e, in the direction of the arrow 32. However, a smaller number of the DOD print heads, including one of the DOD print heads, or a larger number of the DOD print heads, can be used.

[0028] The DOD print heads 26a-e can print using any suitable ink or coating used in drop-on-demand printing and that is suitable for use on the types of cards described herein. For example, the ink can be a UV curable ink, a heat curable ink that can be cured by applying heat to the heat curable ink, or other ink or materials that can be deposited by DOD print heads. In the case of the five DOD print heads 26a-e, each DOD print head can print a specific color ink. For example, the DOD print head 26d can print cyan colored ink, the DOD print head 26c can print magenta colored ink, the DOD print head 26b can print yellow colored ink, the DOD print head 26a can print black ink, and the DOD print head 26e can print white ink. An example of a drop-on-demand printer that prints using UV curable ink in a card printing system is the Persomaster card personalization system available from Atlantic Zeiser GmbH of Emmingen, Germany.

[0029] Figure 5 is a close-up view of one of the DOD print heads, for example the DOD print head 26d. The other DOD print heads 26a-c,e can have an identical construction as the DOD print head 26d. However, the construction of the print heads 26a-e can differ from one another. The construction and operation of the DOD print head 26d is identical to the construction and operation of DOD print heads known in the art. The DOD print head 26d includes a bottom surface 34 that faces downward toward the card to be printed on. A nozzle plate 36, through which ink is ejected, is provided on a portion of the bottom surface 34 generally centrally

thereon leaving side portions 38a, 38b of the bottom surface 34 not covered by the nozzle plate 36.

[0030] Returning to Figure 2, the automated cleaning mechanism 28 is configured to clean the nozzle plates 36 of the DOD print heads 26a-e without physically contacting the nozzle plates 36. The automated cleaning mechanism 28 can have any configuration that is capable of automatically cleaning the nozzle plates 36 without physically contacting the nozzle plates 36.

[0031] In the example illustrated in Figure 2, the automated cleaning mechanism 28 includes a cleaning carriage 40 that is movable underneath the DOD print heads 26a-e back and forth in the direction of the arrow 42 (generally perpendicular to the transport direction 32 of the card 30) relative to the DOD print heads 26a-e. Figure 2 shows the cleaning carriage 40 in a home or non-cleaning position. The cleaning carriage 40 can be actuated from the home position in a direction toward and underneath the DOD print heads 26a-e, and thereafter back to the home position.

[0032] A cleaning assembly 44 is mounted on the cleaning carriage 40 near one end thereof and is movable therewith. In addition, a drip tray 46 is formed on the cleaning carriage 40 next to and to the rear of (in the direction of movement of the cleaning carriage 40 toward the DOD print heads 26a-e) the cleaning assembly 44 so that at the home position shown in Figure 2 the cleaning assembly 44 is initially closer to the DOD print heads 26a-e than is the drip tray 46. The cleaning assembly 44 is configured to clean the nozzles plates 36 without physically contacting the nozzle plates 36. The drip tray 46 provides an area for cleaning fluid along with loosened ink and other debris to drip onto, where the cleaning fluid has been applied to the nozzles plates 36 during a cleaning process by the cleaning assembly 44. The drip tray 46 has an area that is large enough to encompass at least the total area of the nozzle plates 36.

[0033] In the example illustrated in Figure 2, the cleaning assembly 44 includes a plurality of individual and separate cleaning blocks 50a-e, each cleaning block 50a-e being associated with a respective one of the DOD print heads 26a-e. The cleaning block 50e for the print head 26e is hidden from view in Figure 2 but is partially visible in Figures 6A and 6B and is located next to

(i.e. to the right of) the cleaning block 50a. For example, the cleaning block 50a can be associated with the DOD print head 26a for cleaning the DOD print head 26a; the cleaning block 50b can be associated with the DOD print head 26b for cleaning the DOD print head 26b; etc. Each cleaning block 50a-e can be independently movably mounted on the cleaning carriage 40 wherein each cleaning block 50a-e can be movable independently of the other cleaning blocks and each cleaning block 50a-e is movable relative to the cleaning carriage 40.

[0034] The cleaning blocks 50a-e can be identical in construction to one another. In another example, some of the cleaning blocks 50a-e may be different from one another, for example to optimize cleaning blocks for different print head geometries. Referring to Figures 3 and 4, the cleaning block 50d will be described, it being understood that the other cleaning blocks 50a-c, e can have the same construction. The cleaning block 50d has a block body 52 having a length L, a width W, and a height H. A flush orifice 54 and a vacuum orifice 56 are defined near the top of the block body. The flush orifice 54 is configured to apply a cleaning fluid to the nozzle plate 36. The vacuum orifice 56 is configured to remove the cleaning fluid along with any loosened ink and other debris from the nozzle plate 36.

[0035] A pivot opening 58 is formed in, for example through, the block body 52 extending in the direction of the width W of the bock body 52. As shown in Figure 3, a pivot shaft 60 extends through the aligned pivot openings 58 of the block bodies 52 of the cleaning blocks 50a-e. The pivot shaft 60 is fixed to the cleaning carriage 40, and the block bodies 52 of the cleaning blocks 50a-e can individually and separately pivot about the pivot shaft 60.

[0036] Returning to Figure 4, the block body 52 further includes a pivot limiting opening 62 that extends in the direction of the width W of the block body 52 parallel to the pivot opening 58. The pivot limiting opening 62 is spaced from the pivot opening 58 in the direction of the length L of the block body 52. As seen in Figure 3, a shaft 64 that is fixed to the cleaning carriage 40 extends through the aligned pivot limiting openings 62 of the block bodies 52. The pivot limiting opening 62 has a diameter that is greater than the diameter of the shaft 64. The pivot range of the block body 52 about the pivot shaft 60 is limited by the clearance between the diameter of the shaft 64 and the diameter of the pivot limiting opening 62.

[0037] The pivotable mounting of the cleaning blocks 50a-e permits each individual cleaning block to self-adjust a small distance toward and away from its associated DOD print head 26a-e, with the adjustment distance limited by the clearance between the diameter of the shaft 64 and the diameter of the pivot limiting opening 62.

[0038] Returning to Figure 4, the block body 52 also includes first and second side rails 66a, 66b. The first and second side rails 66a, 66b extend in the direction of the length L of the block body 52, and in the illustrated example extend the entire length L of the block body 52. The first and second side rails 66a, 66b are spaced from each other in the direction of the width W of the block body 52, with the flush orifice 54 and the vacuum orifice 56 disposed between the first and second side rails 66a, 66b. Each of the first and second side rails 66a, 66b has an upper edge 68, and the upper edge 68 is spaced above the flush orifice 54 and the vacuum orifice 56, i.e. the flush orifice 54 and the vacuum orifice 56 are located a distance below the upper edges 68 of the side rails 66a, 66b. A wear indicator groove 70 is formed in the upper edge 68 of each of the side rails 66a, 66b and extends the entire length of each side rails 66a, 66b. The wear indicator groove 70 provides an indication when the cleaning block 50d is worn to the point of needing replacement.

[0039] Referring to Figure 5, during a cleaning operation, the cleaning block 50d is positioned close to the bottom surface 34 of the DOD print head 26d, with the upper edges 68 of the side rails 66a, 66b in close proximity to (but not in direct physical engagement with) or in direct physical engagement with the side portions 38a, 38b next to the nozzle plate 36, and the cleaning orifice 54 and the vacuum orifice 56 spaced below the nozzle plate 36. Although the cleaning block 50d may physically contact the DOD print head 26d, no portion of the cleaning block 50d is in direct physical contact with the nozzle plate 36.

[0040] Figure 8 shows another embodiment of a cleaning assembly 144 where cleaning blocks 150 for each print head can move in a vertical direction in order to self-adjust a small distance toward and away from its associated DOD print head. In this embodiment, each cleaning block 150 includes a block body 152 that is generally similar to the construction of the block body 52.

However, the block body 152 includes a vertically elongated (or oval) opening 158 and another opening 162. A shaft 160 extends through the aligned openings 158 of the block bodies 152. As with the pivot shaft 60, the shaft 160 is fixed to the cleaning carriage of the cleaning assembly 144, and the block bodies 152 can individually and separately move vertically up and down (in a linear direction) toward and away from their respective print heads. In addition, a shaft 164 that is fixed to the cleaning carriage extends through the aligned openings 162 of the block bodies 152. The opening 162 has a diameter that is greater than the diameter of the shaft 164. The extent of vertical movement of the block body 152 is limited by the clearance between the diameter of the shaft 164 and the diameter of the opening 162.

[0041] Each block body 152 is spring-biased upwardly in the vertical direction by a suitable resilient biasing member that acts directly or indirectly on the block body 152. For example, in the example illustrated in Figure 8, a vacuum port fitting 200 that is in fluid communication with the vacuum orifice 56 is disposed at the base of the block body 152. A spring tab 202 that is fixed to the cleaning carriage acts on the vacuum port fitting 200 to resiliently bias the block body 152 vertically upward.

[0042] A flush port fitting 204 that is in fluid communication with the flush orifice 54 is fixed to the side of the block body 152. Cleaning fluid for cleaning the nozzle plate of the associated print head is introduced into the block body 152 via the flush port fitting 204 and then flows to the flush orifice 54.

[0043] Referring to Figures 4 and 7, the flush orifice 54 is in fluid communication with a flush channel 72 that is formed in the block body 52. Each flush channel 72 is fluidly connected to the output of a pump 76 such as a peristaltic pump. The inlet of the pump 76 is connected to a cleaning fluid tank 78 that contains a refillable supply of cleaning fluid. The cleaning fluid can be any fluid that is suitable for cleaning the nozzle plates 36, such as water, a solution of water and a cleaning agent, or other cleaning fluid. In another embodiment, each flush channel 72 can be fluidly connected to a fluid manifold (not shown) that in turn is connected to the output of the pump 76.

[0044] Still referring to Figures 4 and 7, the vacuum orifice 56 is in communication with a vacuum channel 80 that is formed in the block body 52. Each vacuum channel 80 is connected to the inlet of its own vacuum pump 84. The outlets of the vacuum pumps 84 are connected to a waste storage tank 86 (or connected to separate waste storage tanks 86) into which cleaning fluid and loosened debris and other debris can be discharged when suctioned from the nozzle plates 36 by the vacuum orifices 56. In another embodiment, each vacuum channel 80 can be fluidly connected to a vacuum manifold that is connected to the inlet of a single vacuum pump 84.

[0045] Operation of the automated cleaning mechanism 28 will now be described with reference to Figures 6A and 6B. The automated cleaning mechanism 28 can perform a cleaning operation at any desired time, for example upon receiving a cleaning command entered by a human operator of the card processing system 10, automatically after the card processing system 10 has processed a predetermined number of cards, automatically after the card processing system 10 has finished processing a batch of cards, automatically upon power up or power down of the card processing system 10, or the like.

[0046] Figure 6A shows the cleaning carriage 40 after it has moved away from the home position and has reached a position where the cleaning assembly 44 is ready to apply cleaning fluid to the nozzle plates 36 of the print heads 26a-e. If the cleaning assembly 44 is configured with the cleaning blocks 50a-e as described above, the pump 76 is then activated to pump cleaning fluid to the flush orifices 54. A dome of cleaning fluid is created at each flush orifice 54 with the cleaning fluid dome extending above the flush orifice a sufficient distance to contact the associated nozzle plate 36. As the cleaning carriage 40 continues traveling in the direction of the arrow 42 in Figure 6A, the cleaning fluid is applied to the nozzle plate 36. The cleaning carriage 40 continues traveling in the direction of the arrow 42 in Figure 6A until the cleaning fluid is applied to substantially the entire face of each nozzle plate 36, at which time the pump 76 is stopped.

[0047] The cleaning carriage 40 eventually reaches the position (which can be referred to as a soak position) shown in Figure 6B where the drip tray 46 is positioned underneath the print heads 26a-e. In some embodiments, the cleaning carriage 40 can remain at this position for a

predetermined period of time to allow the cleaning fluid on the nozzle plates 36 to soften any ink or other debris on the nozzle plates 36. Alternatively, the cleaning carriage 40 can immediately return toward the home position shown in Figure 2. As the cleaning carriage 40 returns toward the home position in the direction of the arrow 42 in Figure 6B, the vacuum pumps 84 are activated to create a vacuum in the vacuum orifices 56. As the vacuum orifices 56 travel underneath the nozzle plates 36, they suction cleaning fluid and loosened ink and other debris from the nozzle plates 36. Once the vacuum orifices 56 traverse under the entire length of the nozzle plates 36, the vacuum pumps 84 are stopped and the cleaning carriage 40 continues traveling to the home position.

[0048] In another embodiment, a cleaning sequence can be implemented where a cleaning fluid is not applied to the nozzle plate(s) 36. Instead, in this alternative cleaning sequence, with the cleaning carriage 40 in the soak position shown in Figure 6B where the drip tray 46 is positioned underneath the print heads 26a-e, ink can be forced through the nozzles of one or more of the nozzle plate(s) 36 for unclogging individual nozzles. After the ink is forced through the nozzle plate(s) 36, the cleaning carriage 40 is returned toward the home position in the direction of the arrow 42 in Figure 6B and the vacuum pump(s) 84 are activated so that the vacuum orifices 56 remove residual ink from the nozzle plate(s) 36 as the cleaning carriage 40 returns to the home position.

[0049] When UV curable ink is used for the printing, the card processing system described herein may be configured as what may be referred to as a desktop card processing system. Such a desktop card processing system would include at least a card input and a card output (which may be at opposite ends of the system or at the same end of the system), a DOD card printing system that prints on the cards using UV curable ink, and a UV cure station for curing the UV curable ink applied to the card. Additional card processing systems, such as those described above, may also be included. A desktop card processing system is typically designed for relatively small scale, individual card processing. In desktop processing systems, a single card to be processed is input into the system, processed, and then output. These systems are often termed desktop machines or desktop printers because they have a relatively small footprint intended to permit the machine to reside on a desktop. Many examples of desktop machines are

known, such as the SD or CD family of desktop card machines available from Entrust Datacard Corporation of Shakopee, Minnesota. Other examples of desktop card machines are disclosed in U.S. Patents 7,434,728 and 7,398,972, each of which is incorporated herein by reference in its entirety.

[0050] The following additional embodiments are possible:

[0051] Embodiment 1: A card processing system, comprising:

a card input that is configured to hold a plurality of cards to be processed;

a card output that is configured to hold a plurality of processed cards;

at least one of a magnetic stripe reading/writing system and an integrated circuit chip programming system between the card input and the card output;

a drop-on-demand card printing system between the card input and the card output, the drop-on-demand card printing system is configured to print on a card using ultraviolet curable ink, the drop-on-demand card printing system includes at least one drop-on-demand print head having a nozzle plate;

the drop-on-demand card printing system further includes a cleaning mechanism that is configured to clean the nozzle plate of the at least one drop-on-demand print head without the cleaning mechanism physically contacting the nozzle plate;

an ultraviolet curing station between the card input and the card output, the ultraviolet curing station is configured to cure ultraviolet curable ink applied to a card by the drop-on-demand card printing system.

[0052] Embodiment 2: The card processing system of embodiment 1, wherein the drop-on-demand card printing system includes a plurality of the drop-on-demand print heads each of which has a nozzle plate, and the cleaning mechanism is configured to clean the nozzle plates of the drop-on-demand print heads without the cleaning mechanism physically contacting the nozzle plates.

[0053] Embodiment 3: The card processing system of embodiment 2, wherein the cleaning mechanism includes a plurality of cleaning blocks, each cleaning block associated with a

corresponding one of the drop-on-demand print heads; and each cleaning block includes a flush orifice for applying a cleaning fluid to the nozzle plate of the associated drop-on-demand print head, and each cleaning block also includes a vacuum orifice that is configured to remove cleaning fluid from the nozzle plate of the associated drop-on-demand print head.

[0054] Embodiment 4: The card processing system of embodiment 1, wherein the ultraviolet curing station is between the drop-on-demand card printing system and the card output.

[0055] Embodiment 5: The card processing system of embodiment 1, further comprising each of the magnetic stripe reading/writing system and the integrated circuit chip programming system.

[0056] Embodiment 6: The card processing system of embodiment 1, wherein the at least one magnetic stripe reading/writing system and integrated circuit chip programming system is between the card input and the drop-on-demand card printing system.

[0057] Embodiment 7: The card processing system of embodiment 1, further comprising one or more of:

a) a card embossing system;
b) a card printing system;
c) a laser that performs laser card processing;
d) a laminator;
e) a topcoat station;
f) a quality control station; and
g) a security station,

between the card input and the card output.

[0058] Embodiment 8: A card processing system, comprising:

a card input that is configured to hold a plurality of cards to be processed;

a card output that is configured to hold a plurality of processed cards;

a drop-on-demand card printing system downstream from the card input, the drop-on-demand card printing system is configured to print on a card using ultraviolet curable ink, and

the drop-on-demand card printing system includes at least one drop-on-demand print head having a nozzle plate;

the drop-on-demand card printing system further includes a cleaning mechanism that is configured to clean the nozzle plate of the at least one drop-on-demand print head without the cleaning mechanism physically contacting the nozzle plate;

an ultraviolet curing station downstream from the card input, the ultraviolet curing station is configured to cure ultraviolet curable ink applied to a card by the drop-on-demand card printing system.

[0059] Embodiment 9. The card processing system of embodiment 8, wherein the system is configured to process at least 1000 cards per hour.

[0060] Embodiment 10: A cleaning block of a print head cleaning mechanism, the cleaning block comprising:

a block body having a length and a width;

a flush channel in the block body, the flush channel communicates with a flush orifice;

a vacuum channel in the block body, the vacuum channel communicates with a vacuum orifice;

a first opening in the block body, the first opening extending in the direction of the width of the bock body; and

a second opening in the block body, the second opening extending in the direction of the width of the block body, and the second opening is spaced from the first opening in the direction of the length of the block body.

[0061] Embodiment 11: A cleaning block of a print head cleaning mechanism, the cleaning block comprising:

a block body having a length and a width;

a flush channel in the block body, the flush channel communicates with a flush orifice;

a vacuum channel in the block body, the vacuum channel communicates with a vacuum orifice;

first and second side rails on the block body, the first and second side rails extend in the direction of the length of the block body, and the first and second side rails are spaced from each other in the direction of the width of the block body with the flush orifice and the vacuum orifice disposed between the first and second side rails; and

each of the first and second side rails has an upper edge, and the upper edge projects above the flush orifice and the vacuum orifice.

[0062] Embodiment 12: The cleaning block of a print head cleaning mechanism of embodiment 11, further comprising a wear indicator channel defined in the upper edge of each of the first and second side rails.

[0063] Embodiment 13: A cleaning mechanism of a printer having a plurality of drop-on-demand print heads, comprising:

a cleaning carriage that is movable relative to the drop-on-demand print heads;

a plurality of cleaning blocks mounted on the cleaning carriage and movable therewith, each cleaning block is associated with a respective one of the drop-on-demand print heads;

each cleaning block includes a block body, a flush channel in the block body with the flush channel communicating with a flush orifice, and a vacuum channel in the block body with the vacuum channel communicating with a vacuum orifice;

each cleaning block is independently movably mounted on the cleaning carriage wherein each cleaning block is movable independently of the other cleaning blocks and each cleaning block is movable relative to the cleaning carriage.

[0064] Embodiment 14: The cleaning mechanism of embodiment 13, wherein the cleaning carriage has a home position relative to the drop-on-demand print heads, and in the home position the flush orifice of each cleaning block is closer to the associated drop-on-demand print head than is the vacuum orifice.

[0065] Embodiment 15: The cleaning mechanism of embodiment 13, wherein the cleaning carriage further includes a drip tray that is movable therewith.

[0066] Embodiment 16: A cleaning mechanism of a printer having a plurality of drop-on-demand print heads, comprising:

a cleaning carriage that is movable relative to the drop-on-demand print heads;

at least one cleaning block mounted on the cleaning carriage and movable therewith, the at least one cleaning block includes a block body, a flush channel in the block body with the flush channel communicating with a flush orifice, and a vacuum channel in the block body with the vacuum channel communicating with a vacuum orifice;

the at least one cleaning block is movably mounted on the cleaning carriage whereby the at least one cleaning block is movable relative to the cleaning carriage.

[0067] Embodiment 17: The cleaning mechanism of embodiment 16, wherein the cleaning carriage further includes a drip tray that is movable therewith.

[0068] The examples disclosed in this application are to be considered in all respects as illustrative and not limitative. The scope of the invention is indicated by the appended claims rather than by the foregoing description; and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

CLAIMS

1. A card processing system, comprising:

a card input that is configured to hold a plurality of cards to be processed;

a card output that is configured to hold a plurality of processed cards;

a drop-on-demand card printing system between the card input and the card output, the drop-on-demand card printing system is configured to print on a card using ultraviolet curable ink, the drop-on-demand card printing system includes at least one drop-on-demand print head having a nozzle plate;

the drop-on-demand card printing system further includes a cleaning mechanism that is configured to clean the nozzle plate of the at least one drop-on-demand print head without the cleaning mechanism physically contacting the nozzle plate;

an ultraviolet curing station between the card input and the card output, the ultraviolet curing station is configured to cure ultraviolet curable ink applied to a card by the drop-on-demand card printing system.

2. The card processing system of claim 1, further comprising at least one of a magnetic stripe reading/writing system and an integrated circuit chip programming system between the card input and the card output.

3. The card processing system of claim 1, wherein the drop-on-demand card printing system includes a plurality of the drop-on-demand print heads each of which has a nozzle plate, and the cleaning mechanism is configured to clean the nozzle plates of the drop-on-demand print heads without the cleaning mechanism physically contacting the nozzle plates.

4. The card processing system of claim 3, wherein the cleaning mechanism includes a plurality of cleaning blocks, each cleaning block associated with a corresponding one of the drop-on-demand print heads; and each cleaning block includes a flush orifice for applying a cleaning fluid to the nozzle plate of the associated drop-on-demand print head, and each cleaning block also includes a vacuum orifice that is configured to remove cleaning fluid from the nozzle plate of the associated drop-on-demand print head.

5. The card processing system of claim 1, further comprising one or more of:

a) a card embossing system;

b) a card printing system;

c) a laser that performs laser card processing;

d) a laminator;

e) a topcoat station;

f) a quality control station; and

g) a security station,

between the card input and the card output.

6. The card processing system of claim 1, wherein the system is configured to process at least 1000 cards per hour.

7. A method, comprising:

in a card processing system, processing a plurality of cards, wherein the processing includes:

at least one of reading data from and/or writing data to a magnetic stripe on each card in a magnetic stripe reading/writing system and programming data on an integrated circuit chip on each card in an integrated circuit chip programming system;

printing on each card in a drop-on-demand card printing system using ultraviolet curable ink, the drop-on-demand card printing system includes at least one drop-on-demand print head having a nozzle plate; and

curing the ultraviolet curable ink applied to each card;

cleaning the nozzle plate of the at least one drop-on-demand print head using a cleaning mechanism in the drop-on-demand card printing system, wherein the cleaning mechanism is configured to clean the nozzle plate of the at least one drop-on-demand print head without the cleaning mechanism physically contacting the nozzle plate.

8. The method of claim 7, wherein cleaning the nozzle plate includes:

applying a cleaning fluid to a surface of the nozzle plate using a cleaning block of the cleaning mechanism without the cleaning block physically contacting the nozzle plate;

using a vacuum orifice on the cleaning block to remove the cleaning fluid from the nozzle plate without the cleaning block physically contacting the nozzle plate.

9. The method of claim 7, wherein cleaning the nozzle plate includes:

forcing ink through the nozzle plate;

using a vacuum orifice on a cleaning block of the cleaning mechanism to remove residual ink from the nozzle plate without the cleaning block physically contacting the nozzle plate.

10. A cleaning block of a print head cleaning mechanism, the cleaning block comprising:

a block body having a length and a width;

a flush channel in the block body, the flush channel communicates with a flush orifice in the cleaning block;

a vacuum channel in the block body, the vacuum channel communicates with a vacuum orifice in the cleaning block; and at least one of the following:

a) first and second side rails on the block body, the first and second side rails extend in the direction of the length of the block body, and the first and second side rails are spaced from each other in the direction of the width of the block body with the flush orifice and the vacuum orifice disposed between the first and second side rails; and

each of the first and second side rails has an upper edge, and the upper edge projects above the flush orifice and the vacuum orifice;

b) a first opening in the block body, the first opening extending in the direction of the width of the block body; and

a second opening in the block body, the second opening extending in the direction of the width of the block body, and the second opening is spaced from the first opening in the direction of the length of the block body.

11. The cleaning block of a print head cleaning mechanism of claim 10, further comprising a wear indicator channel defined in the upper edge of each of the first and second side rails.

12. A cleaning mechanism of a printer having a plurality of drop-on-demand print heads, comprising:

a cleaning carriage that is movable relative to the drop-on-demand print heads;

at least one cleaning block mounted on the cleaning carriage and movable therewith, the at least one cleaning block includes a block body, a flush channel in the block body with the flush channel communicating with a flush orifice in the block body, and a vacuum channel in the block body with the vacuum channel communicating with a vacuum orifice in the block body;

the at least one cleaning block is movably mounted on the cleaning carriage whereby the at least one cleaning block is movable relative to the cleaning carriage.

13. The cleaning mechanism of claim 12, wherein the cleaning carriage further includes a drip tray that is movable therewith.

14. The cleaning mechanism of claim 12, comprising a plurality of the cleaning blocks mounted on the cleaning carriage and movable therewith, each cleaning block is associated with a respective one of the drop-on-demand print heads, each cleaning block is independently movably mounted on the cleaning carriage wherein each cleaning block is movable independently of the other cleaning blocks.

15. The cleaning mechanism of claim 14, wherein the cleaning carriage has a home position relative to the drop-on-demand print heads, and in the home position the flush orifice of the at least one cleaning block is closer to the drop-on-demand print head than is the vacuum orifice.

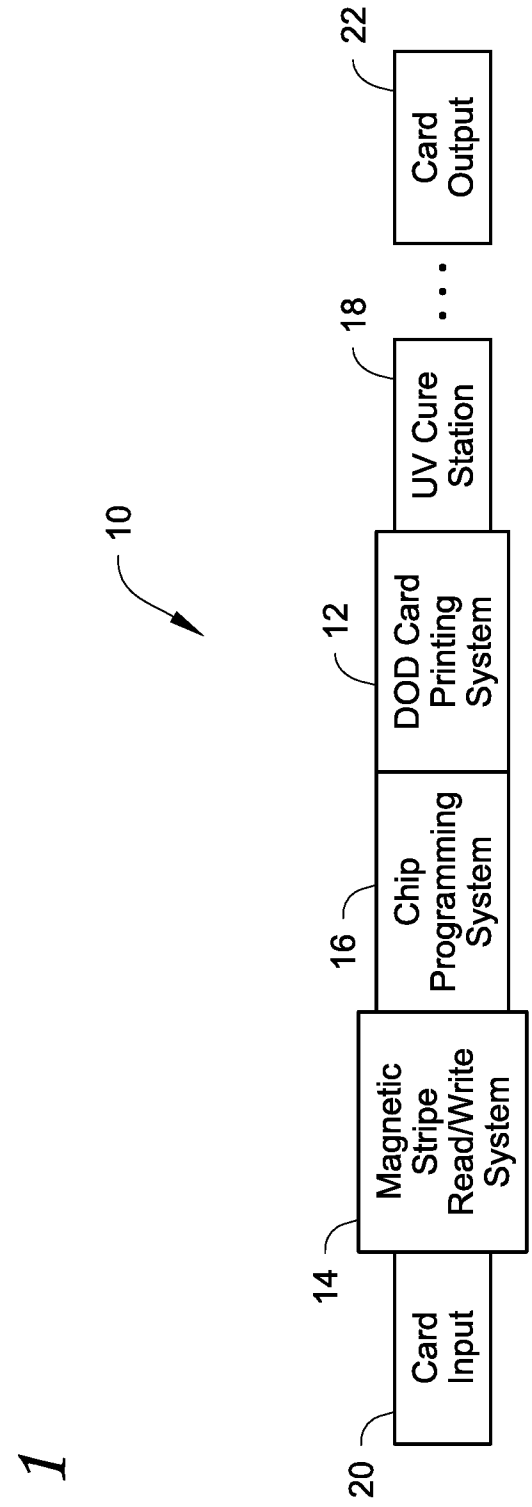

10
20
Card Input
14
Magnetic Stripe Read/Write System
16
Chip Programming System
12
DOD Card Printing System
18
UV Cure Station
22
Card Output

Fig. 1

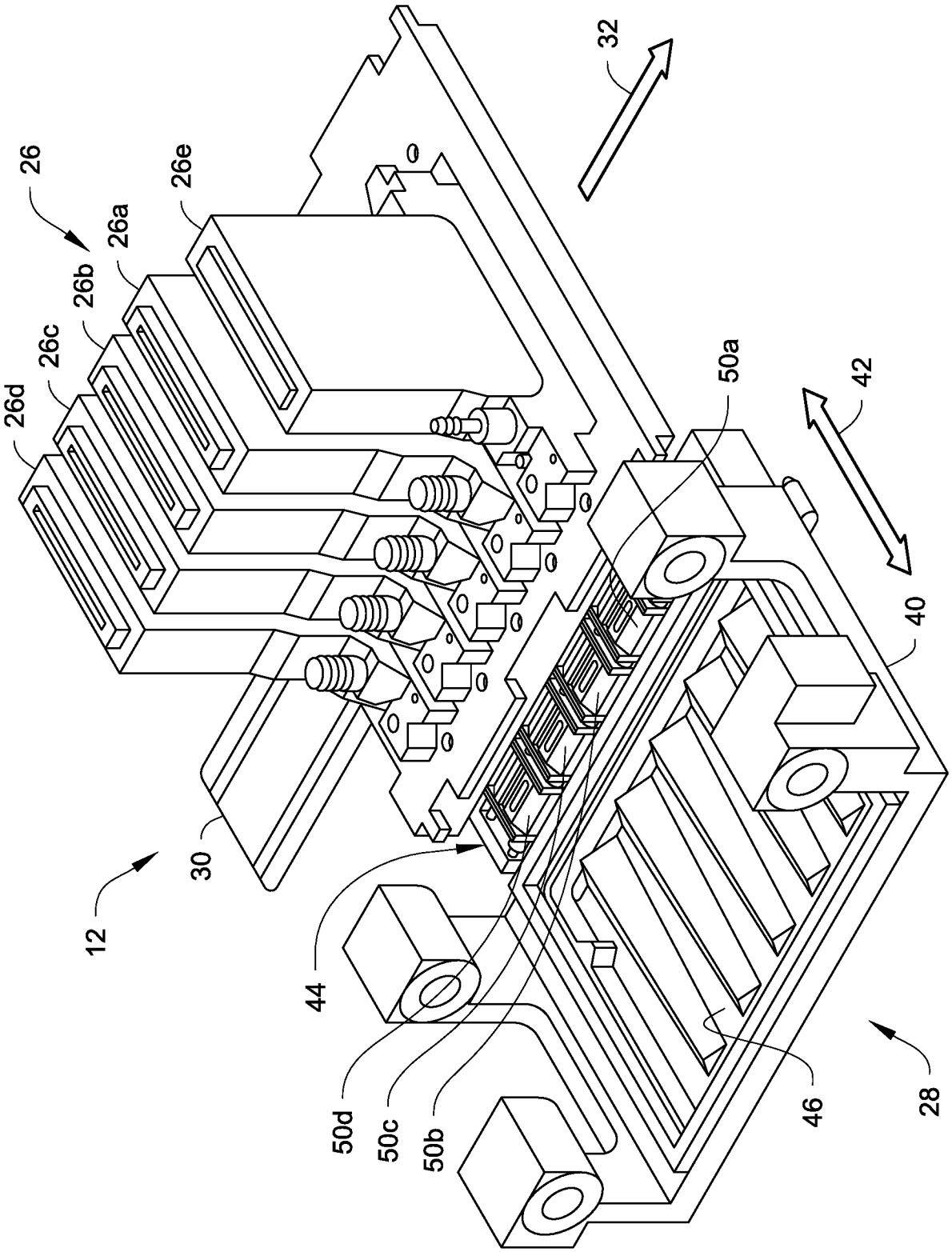


Fig. 2

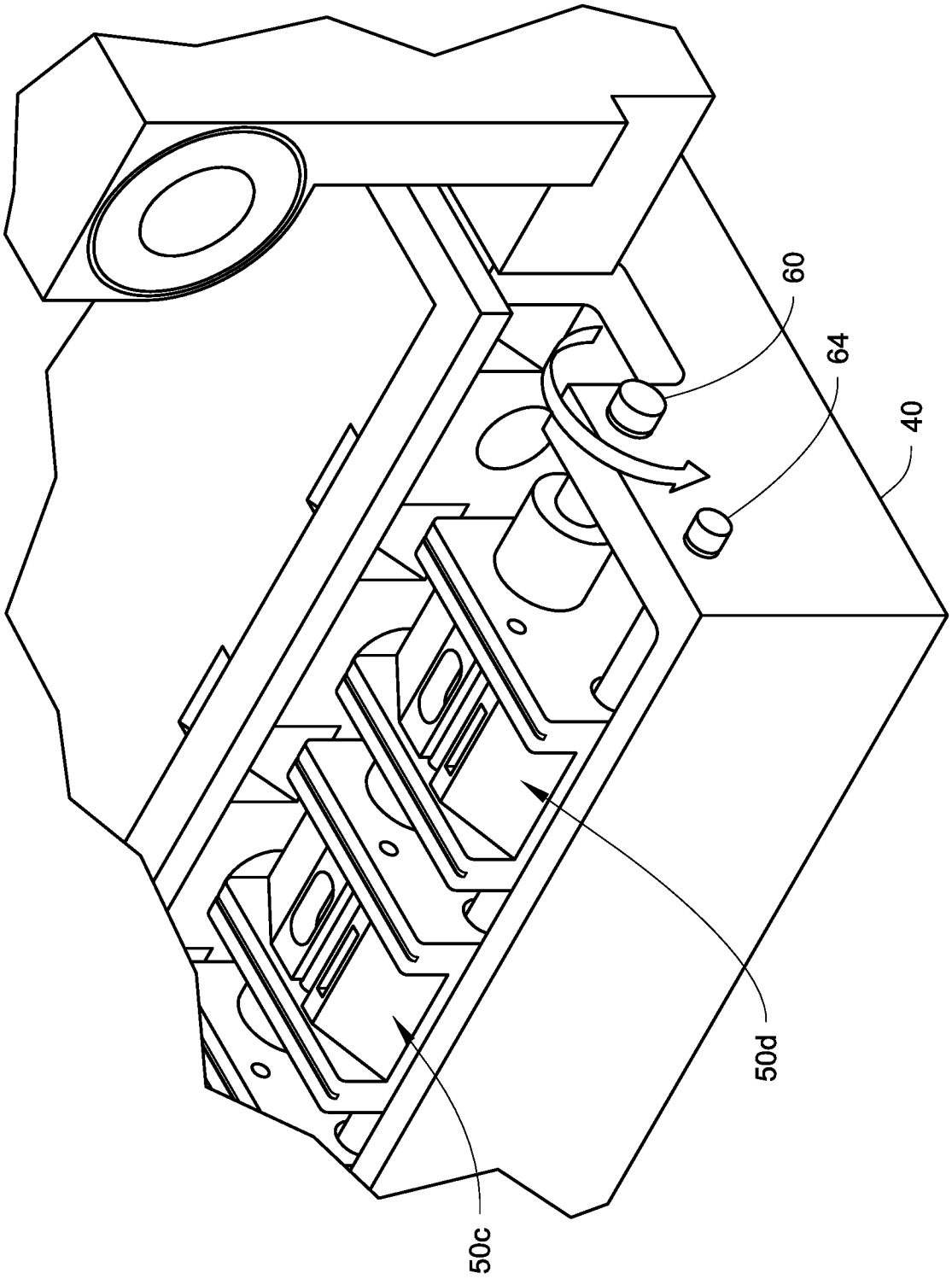


Fig. 3

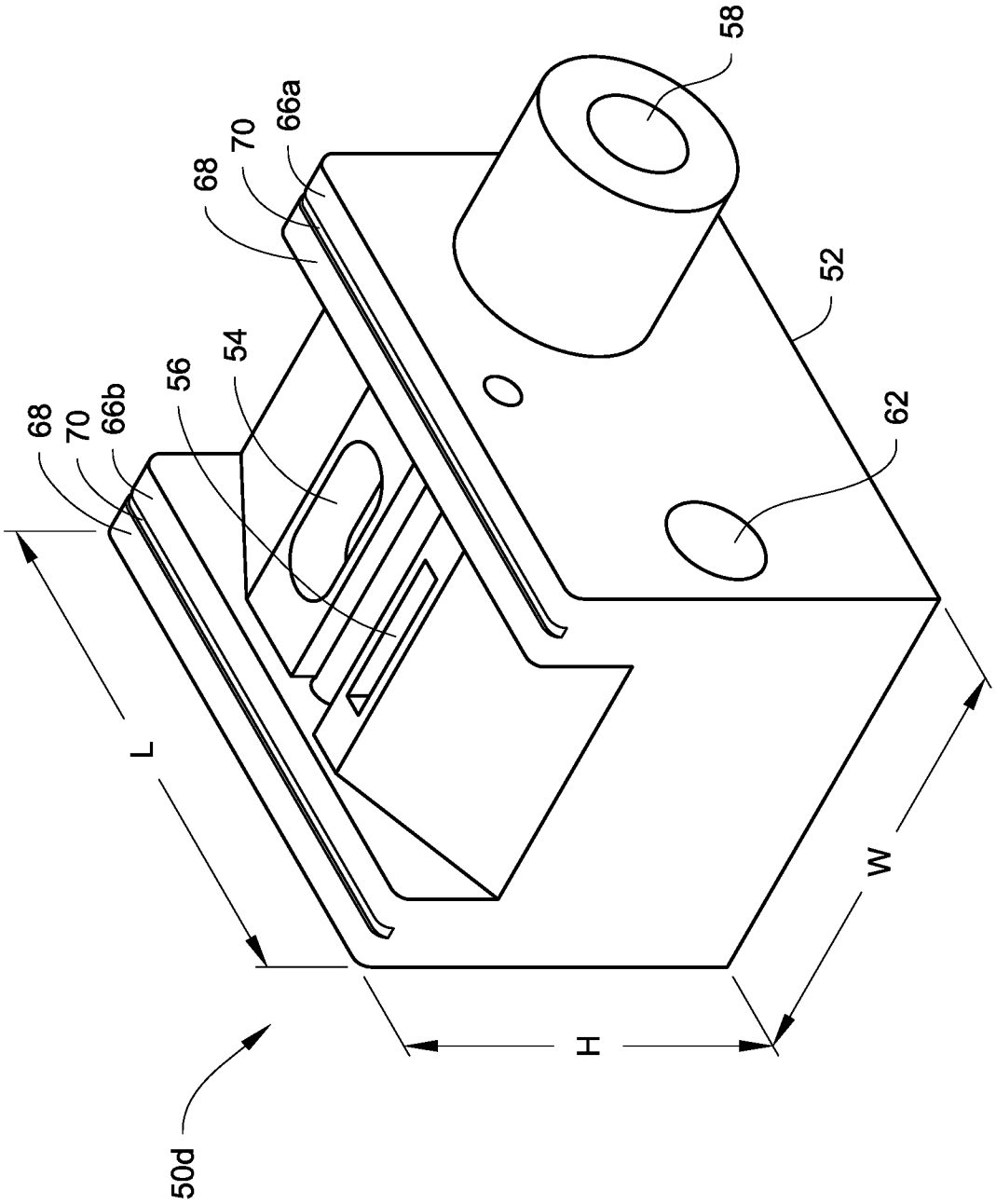


Fig. 4

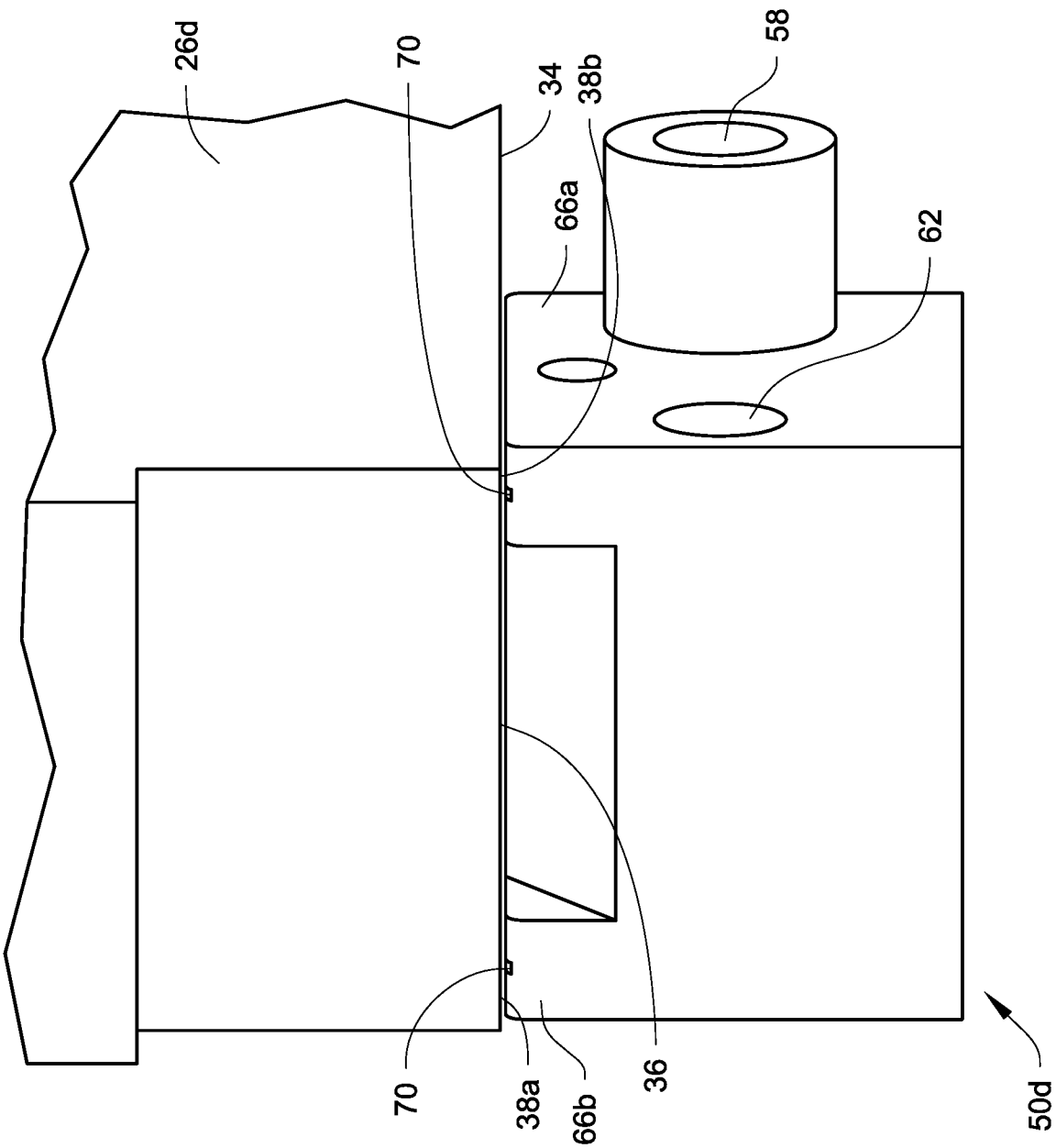


Fig. 5

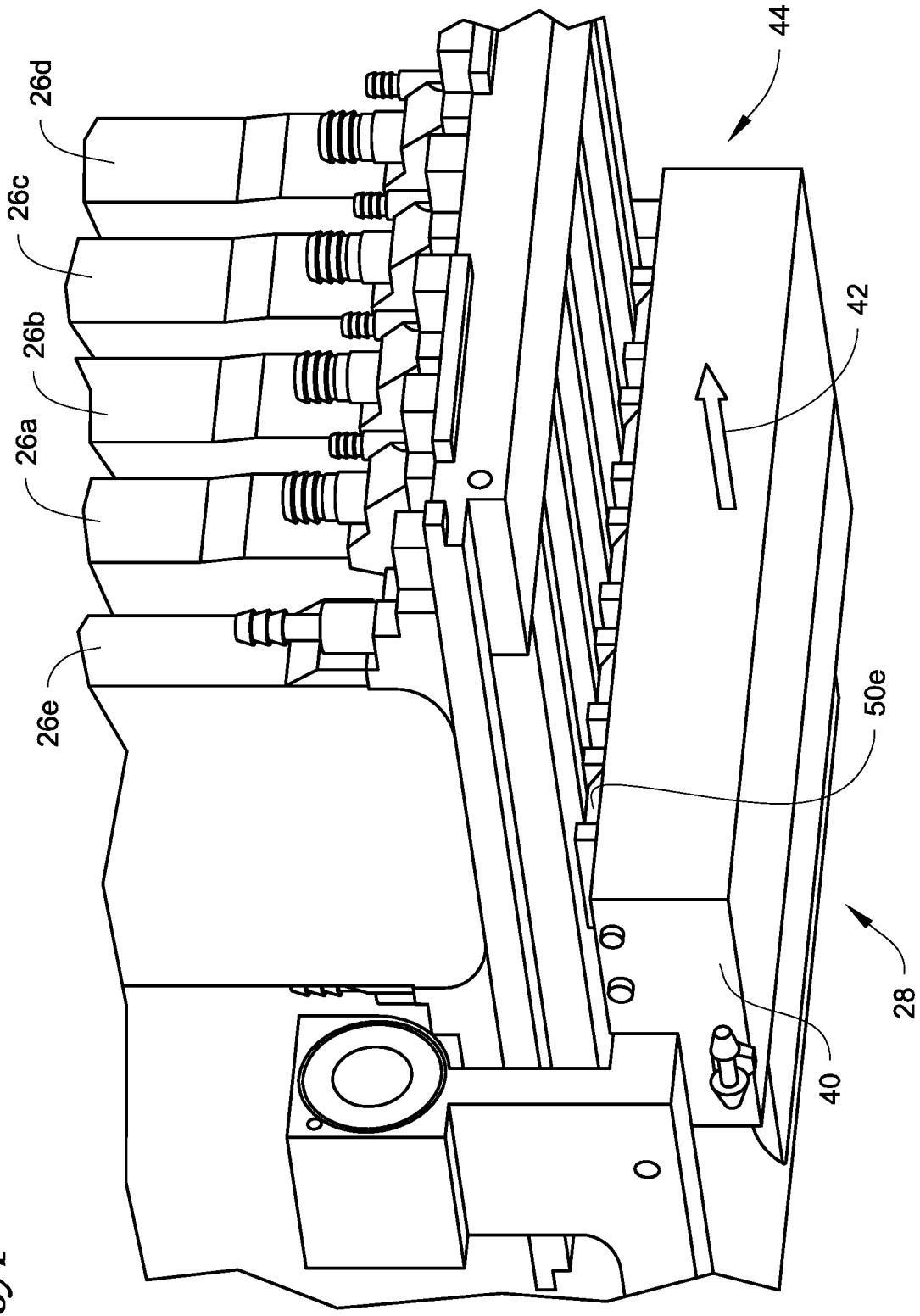


Fig. 6A

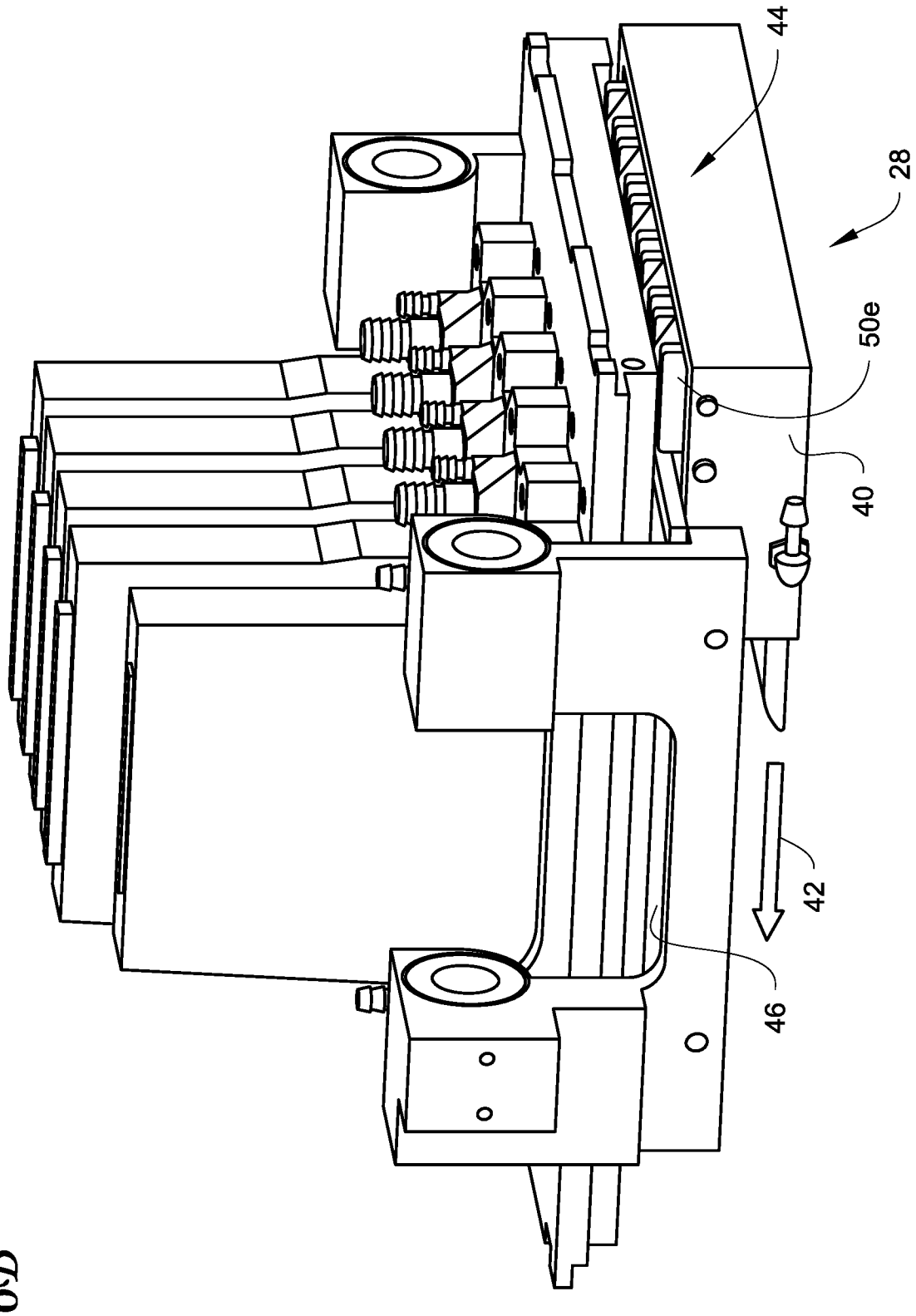


Fig. 6B

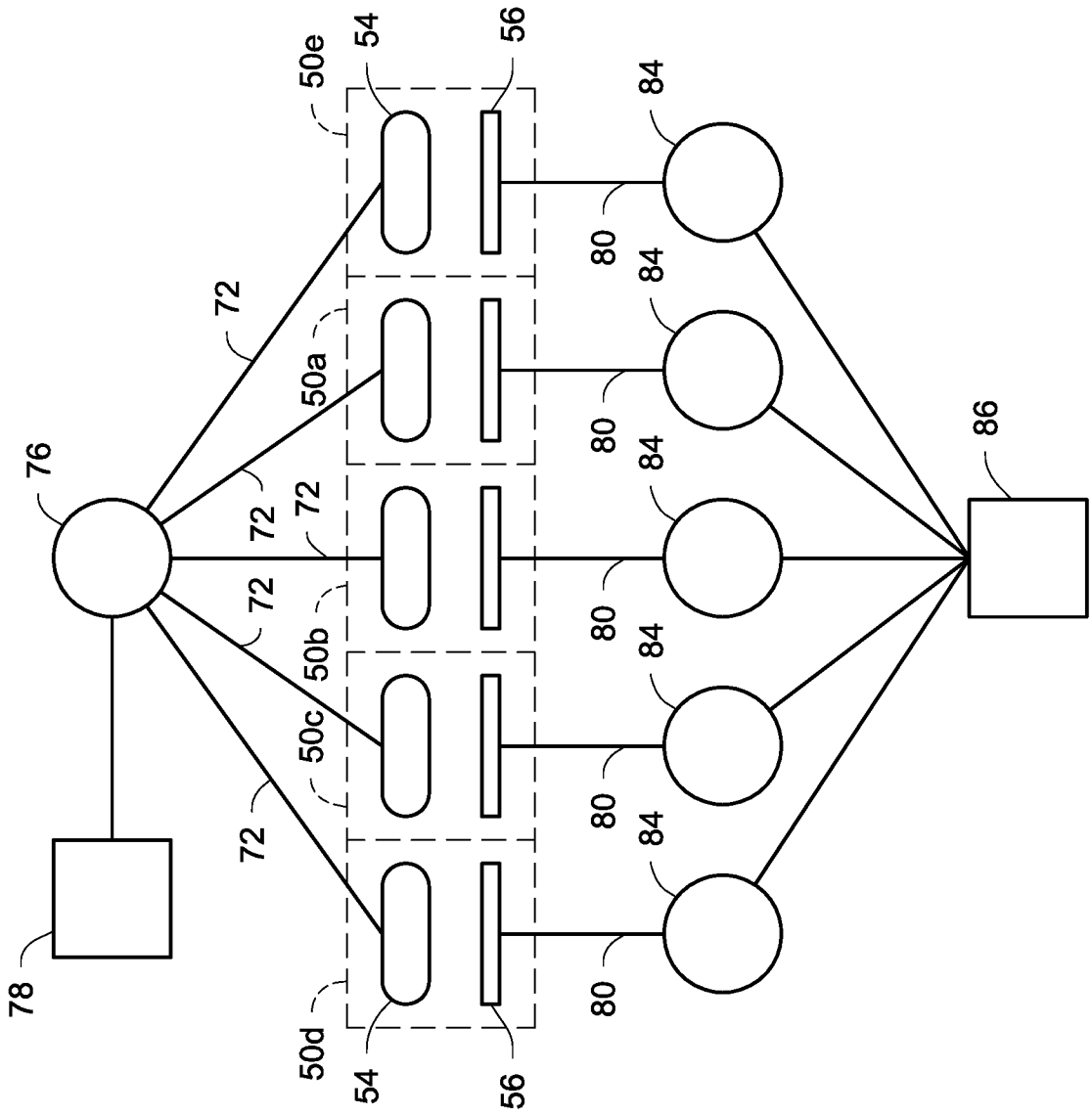

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50d
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Fig. 7

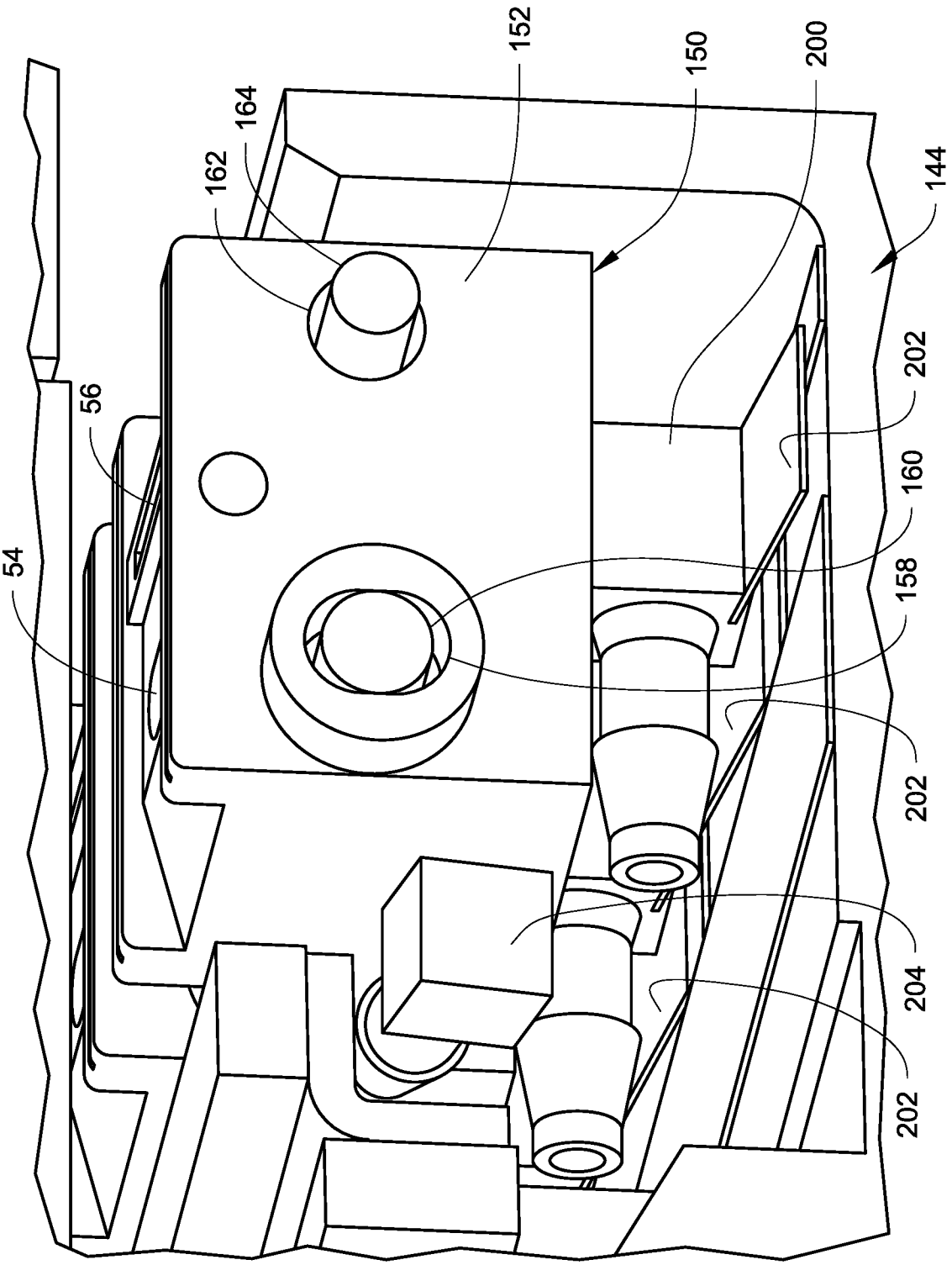


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/049051

A. CLASSIFICATION OF SUBJECT MATTER

B41J 2/14(2006.01)i, B41J 2/165(2006.01)i, C09D 11/30(2014.01)i, B41J 13/12(2006.01)i, G06K 19/077(2006.01)i, B41J 3/38(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B41J 2/14; B41F 35/00; B41J 2/165; B41J 2/17; B41J 2/175; G06K 15/02; C09D 11/30; B41J 13/12; G06K 19/077; B41J 3/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: card, print head, ink, ultraviolet, curing, cleaning, vacuum, flush, magnetic strip, carriage, block, rail, drip tray

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2016-0300128 A1 (ENTRUST DATACARD CORPORATION) 13 October 2016 See paragraphs [0027], [0031], [0033], [0037], [0040], claims 1, 13, and figures 1, 3A.	1-9
A		10-15
Y	JP 2004-230638 A (KONICA MINOLTA HOLDINGS INC.) 19 August 2004 See paragraphs [0020]-[0023], [0040] and figure 1.	1-9
X	US 2005-0104926 A1 (YAMADA et al.) 19 May 2005 See paragraphs [0036], [0041], [0043], claim 1, and figures 1A, 1B, 4, 5.	12
Y		4,8,9,10,13-15
Y	KR 10-1385142 B1 (DILLI) 15 April 2014 See paragraphs [0024]-[0026] and figures 1, 2.	10
Y	US 9162465 B1 (XEROX CORPORATION) 20 October 2015 See column 6, lines 6-22 and figures 2A-3.	13
Y	KR 10-1101061 B1 (DILLI) 29 December 2011 See paragraph [0018] and figure 1.	14,15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 December 2018 (18.12.2018)	**18 December 2018 (18.12.2018)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-481-8578

Authorized officer
KIM, Jin Ho
Telephone No. +82-42-481-8699

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/049051

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group I, Claims 1-9 are directed to a card processing system or the method
Group II, Claims 10-15 are directed to a cleaning block or a cleaning mechanism.

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2018/049051

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016-0300128 A1	13/10/2016	CN 107531061 A	02/01/2018
		EP 3280596 A1	14/02/2018
		EP 3280596 A4	25/04/2018
		KR 10-2017-0134668 A	06/12/2017
		US 2018-0144217 A1	24/05/2018
		US 9904876 B2	27/02/2018
		WO 2016-164699 A1	13/10/2016
JP 2004-230638 A	19/08/2004	None	
US 2005-0104926 A1	19/05/2005	JP 2005-131969 A	26/05/2005
		JP 4403379 B2	27/01/2010
		US 7244012 B2	17/07/2007
KR 10-1385142 B1	15/04/2014	KR 10-2014-0012852 A	04/02/2014
US 9162465 B1	20/10/2015	JP 2016-190484 A	10/11/2016
KR 10-1101061 B1	29/12/2011	None	