



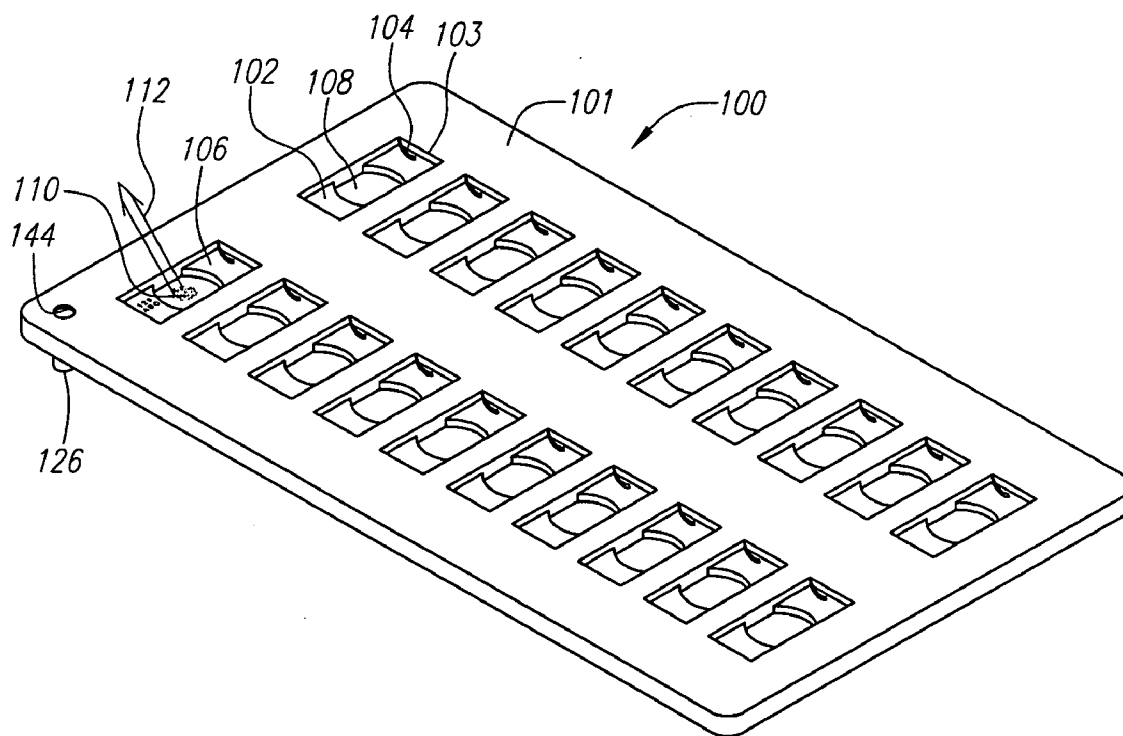
US 20060180489A1

(19) **United States**(12) **Patent Application Publication**
Guiney et al.(10) **Pub. No.: US 2006/0180489 A1**(43) **Pub. Date: Aug. 17, 2006**(54) **SLIDE TRAY****Publication Classification**(75) Inventors: **Patrick Guiney**, Concord, MA (US);
Mark Bangert, Milford, MA (US);
Bernie Lane, Littleton, MA (US);
Mathew McCormack, Lunenburg, MA
(US); **Robert Sakal**, Bolton, MA (US)(51) **Int. Cl.****B65D 85/48** (2006.01)(52) **U.S. Cl.** **206/456**

(57)

ABSTRACTCorrespondence Address:
VISTA IP LAW GROUP LLP
12930 Saratoga Avenue
Suite D-2
Saratoga, CA 95070 (US)

Apparatus and methods for loading a tray containing a plurality of slides into an imaging system, and for verifying the alignment and orientation of the tray in the imaging system. A plurality of retainers secures the slides in recesses defined by the tray. An aligning projection on the tray interacts with an alignment component on the imaging system to verify the alignment and orientation of the tray in the imaging system and to disable the system if it cannot do so.

(73) Assignee: **Cytoc Corporation**, Marlborough, MA(21) Appl. No.: **11/050,547**(22) Filed: **Feb. 2, 2005**

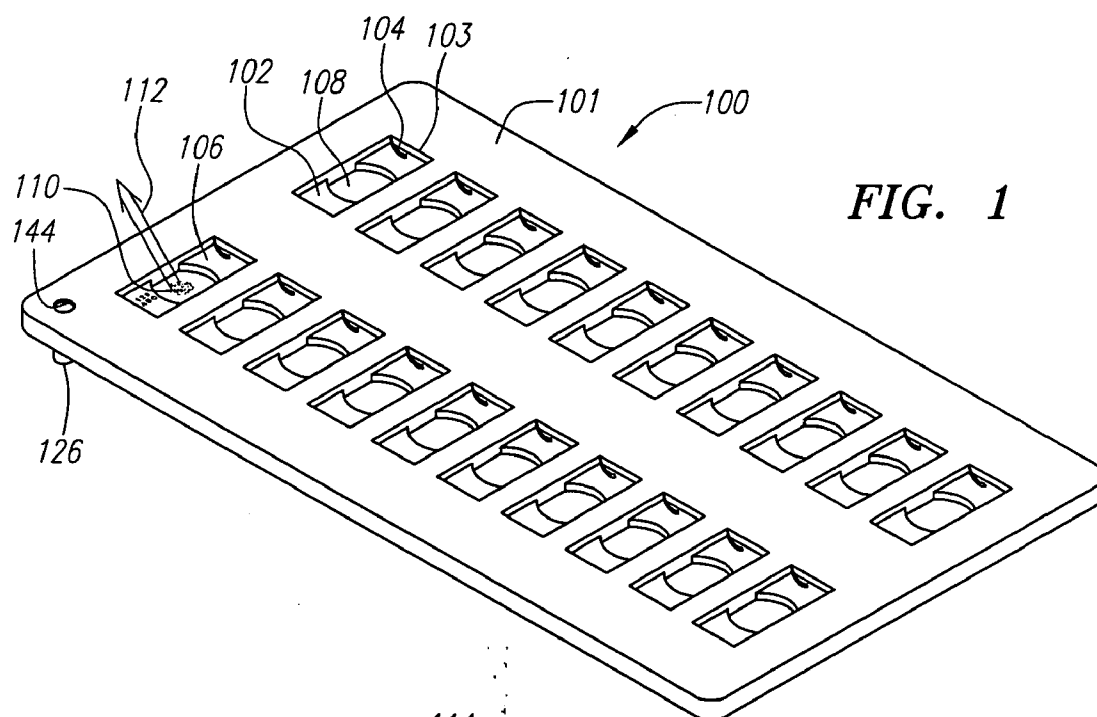


FIG. 1

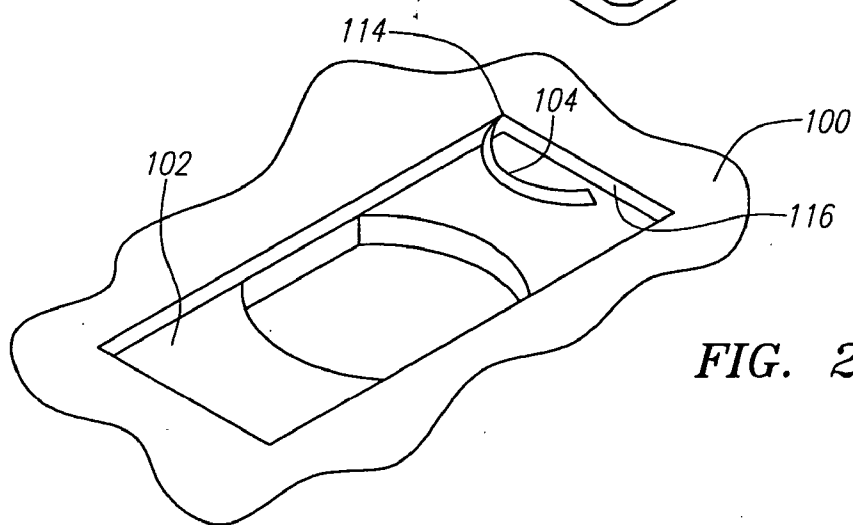


FIG. 2A

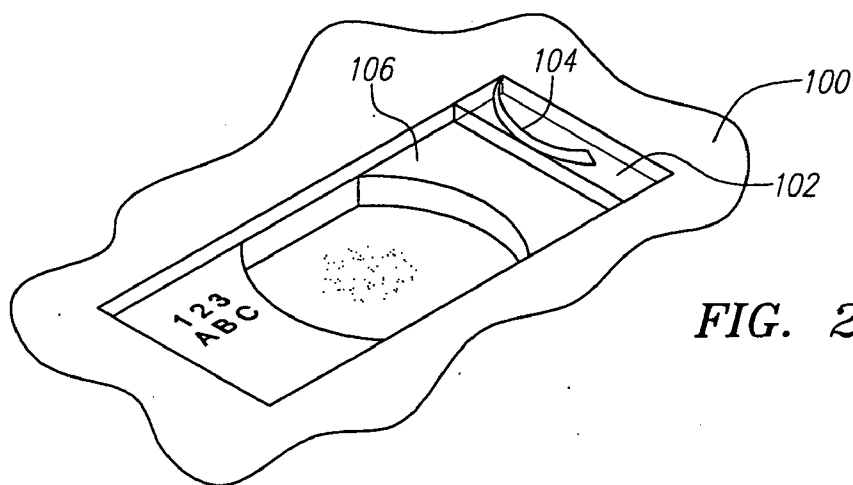
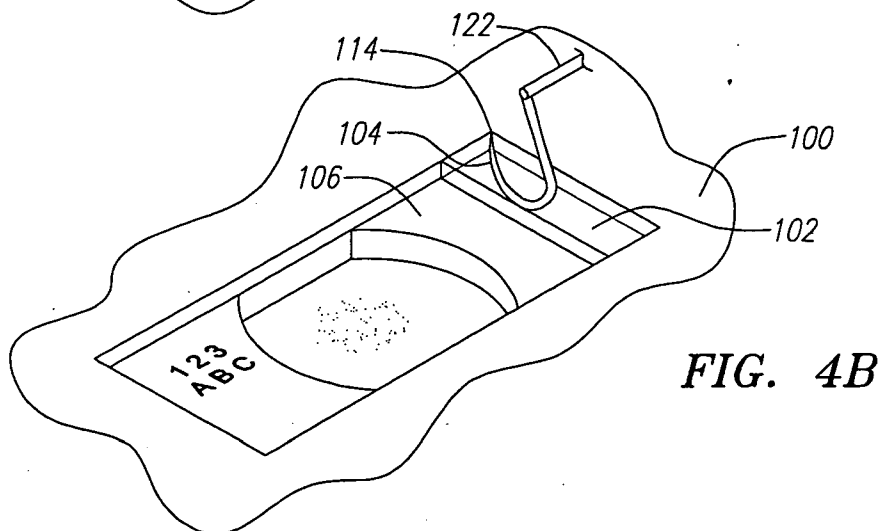
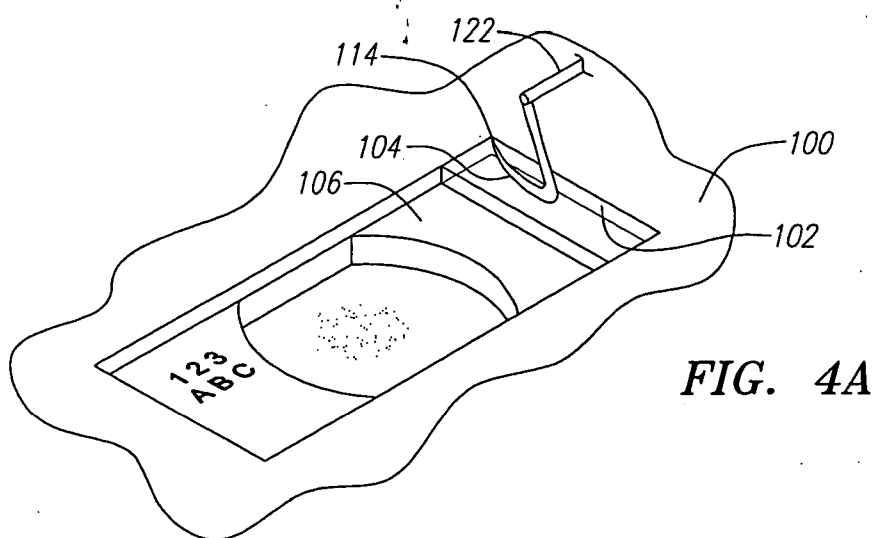
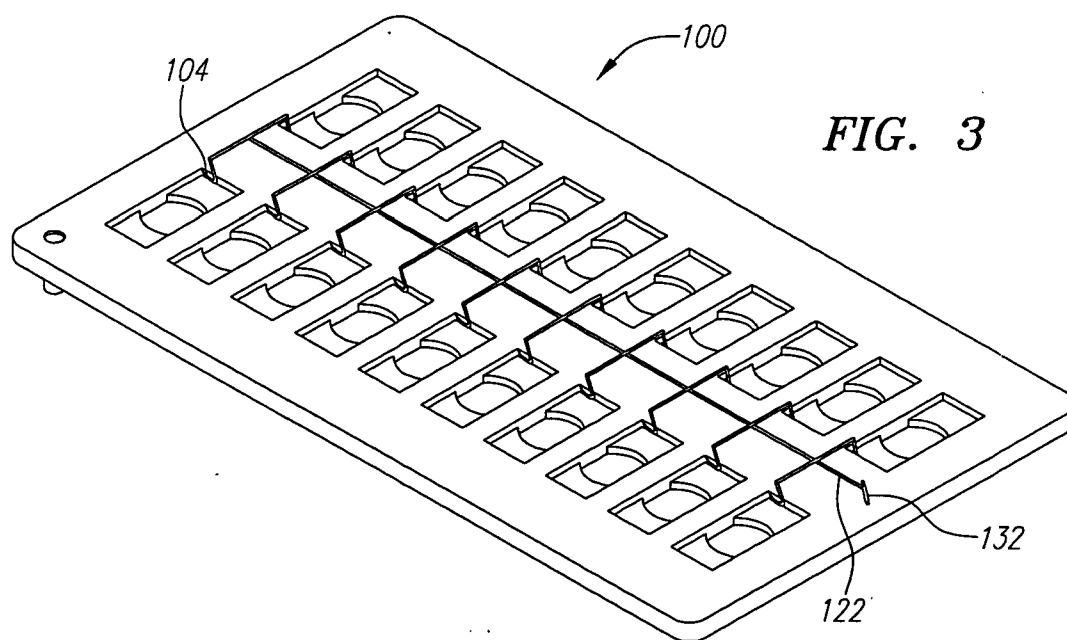


FIG. 2B



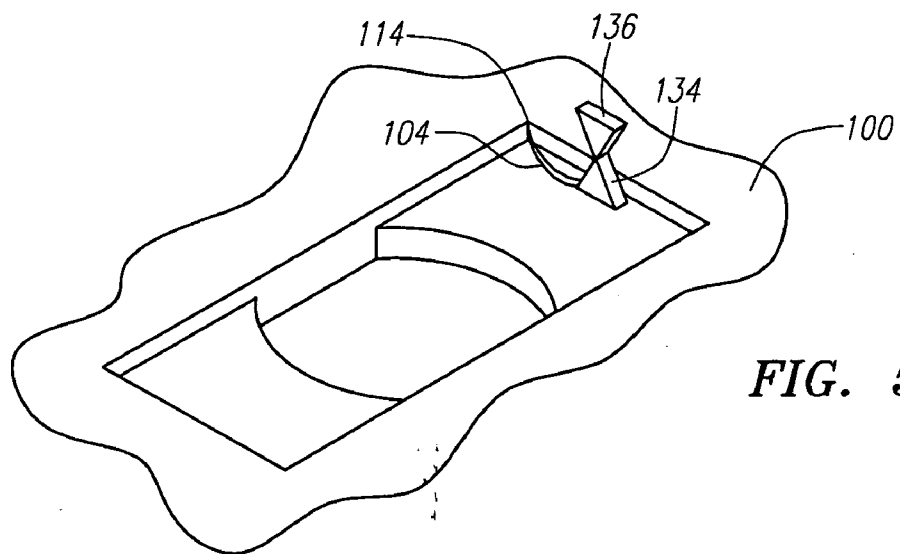


FIG. 5

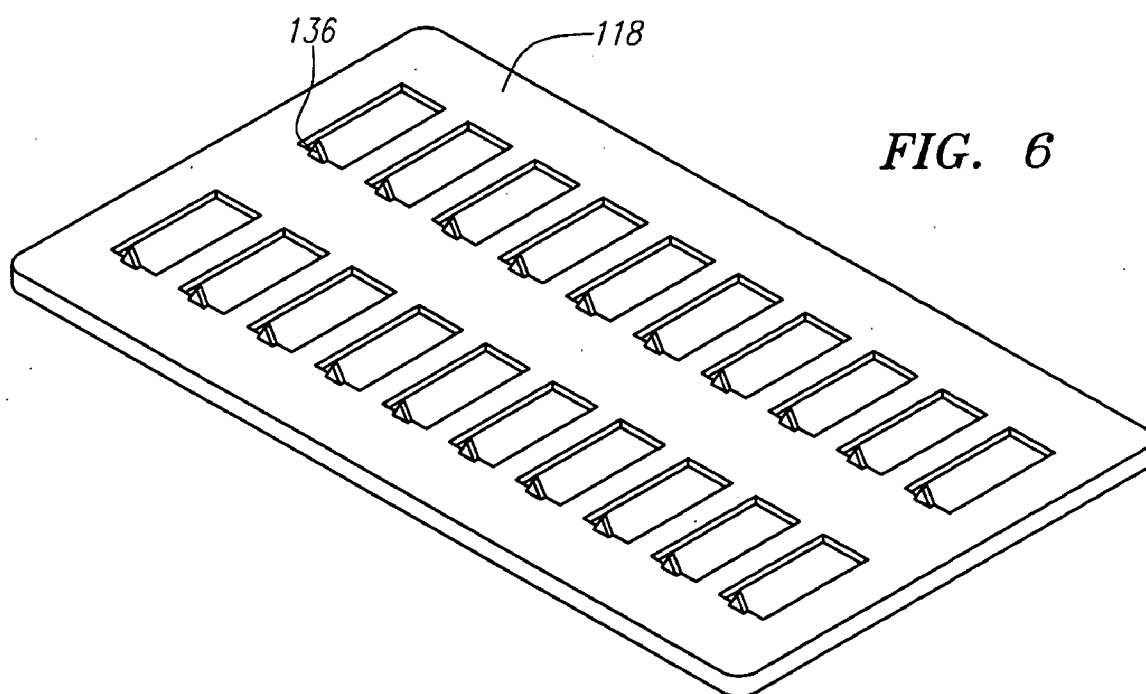


FIG. 6

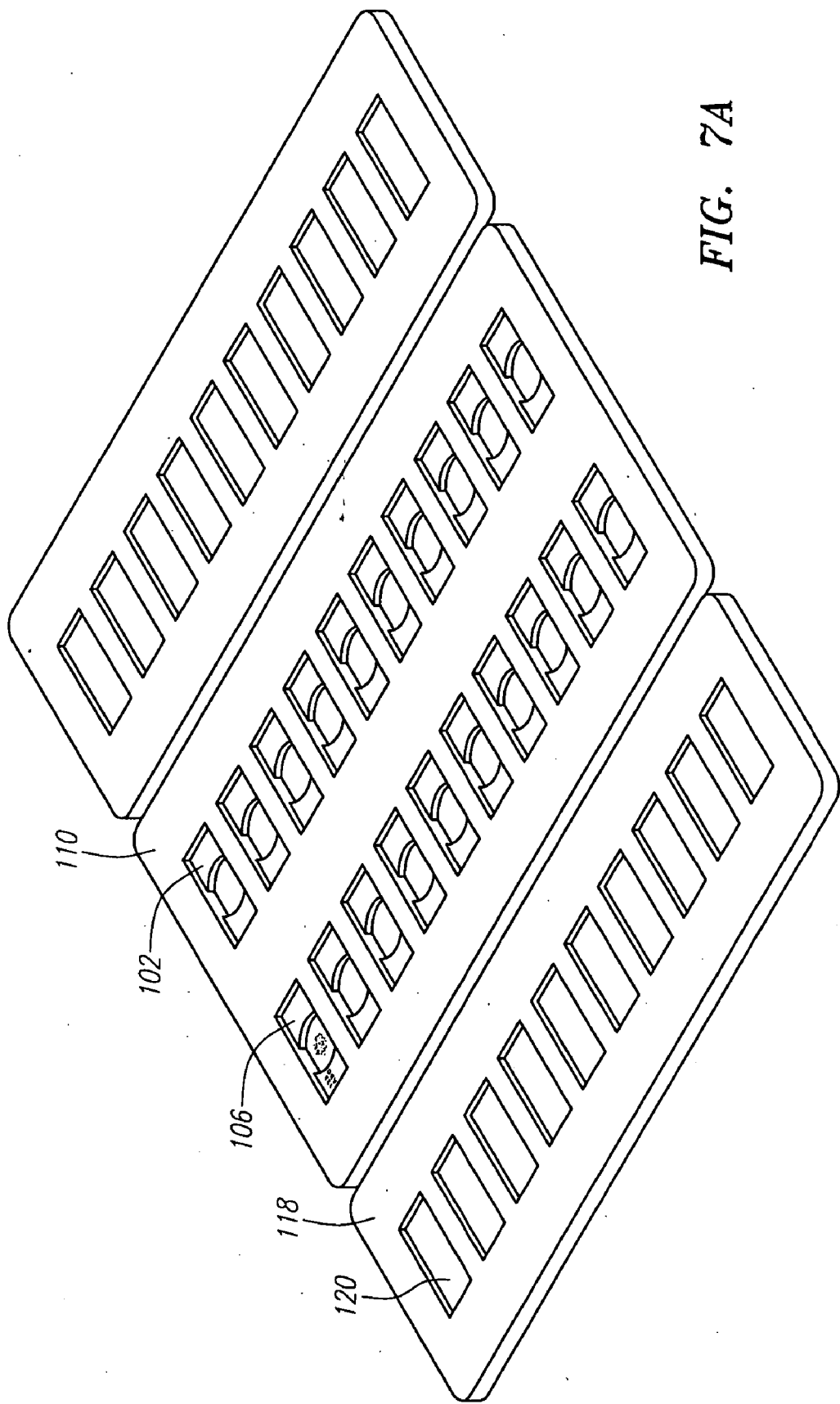


FIG. 7A

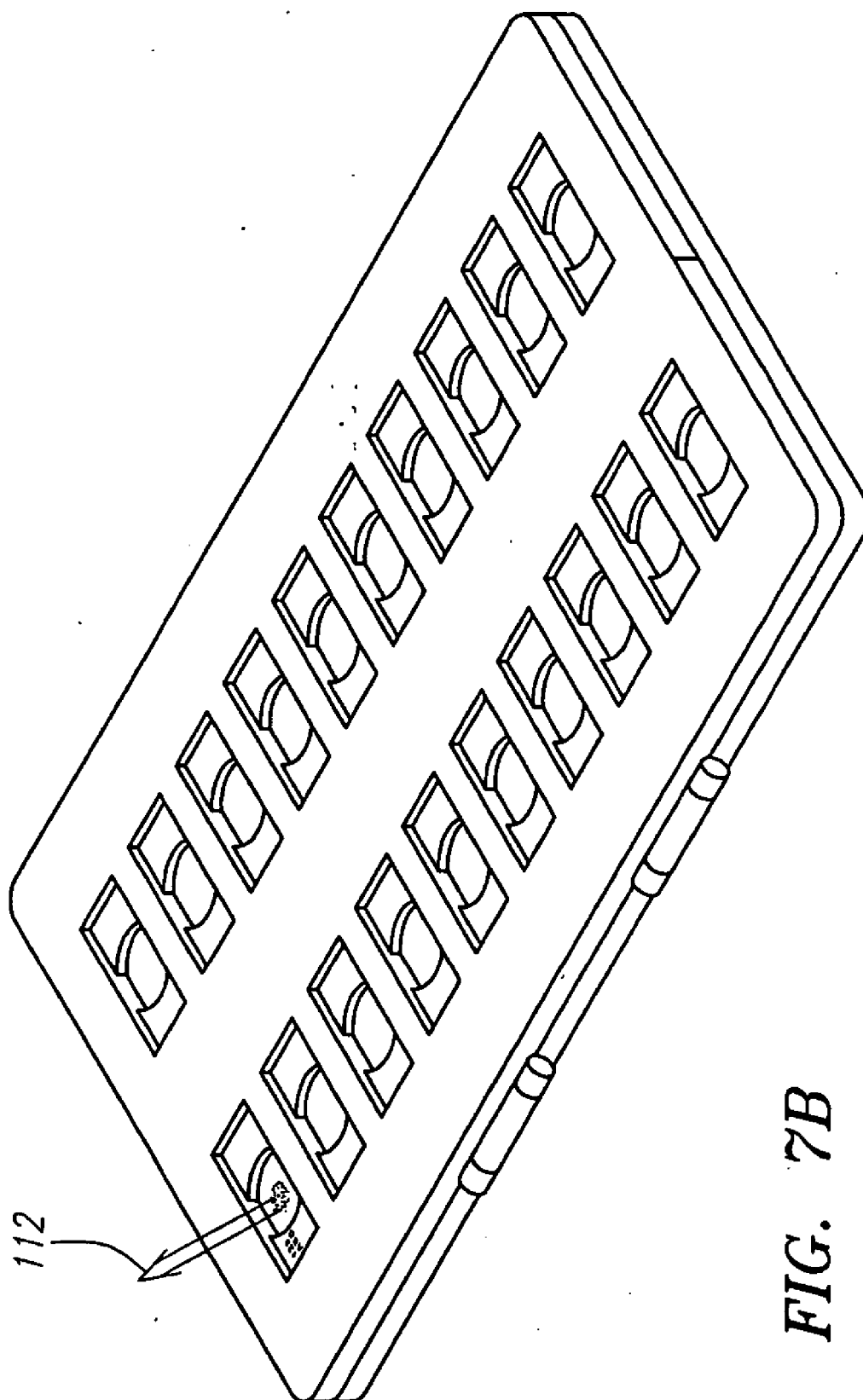


FIG. 7B

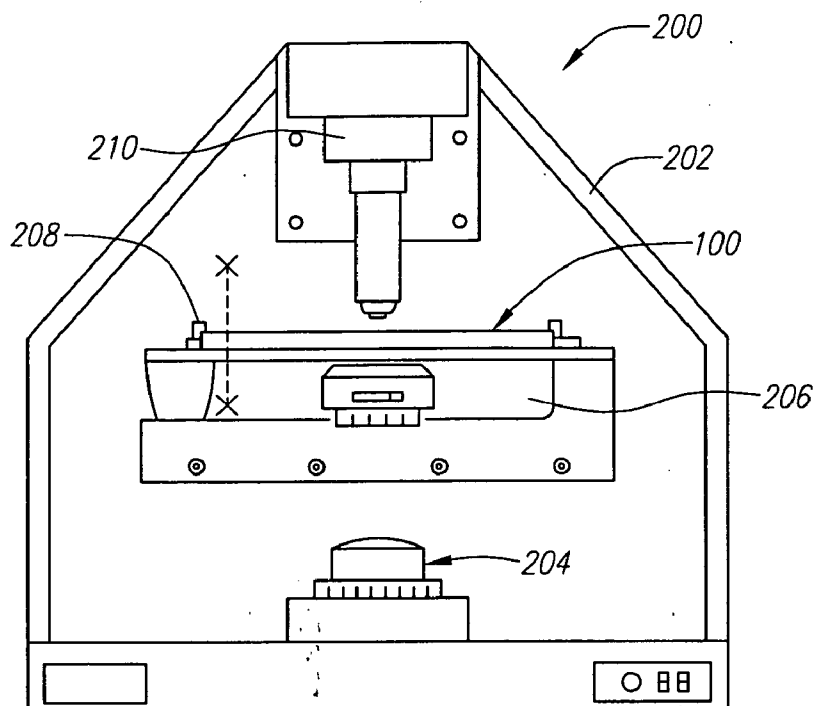


FIG. 8

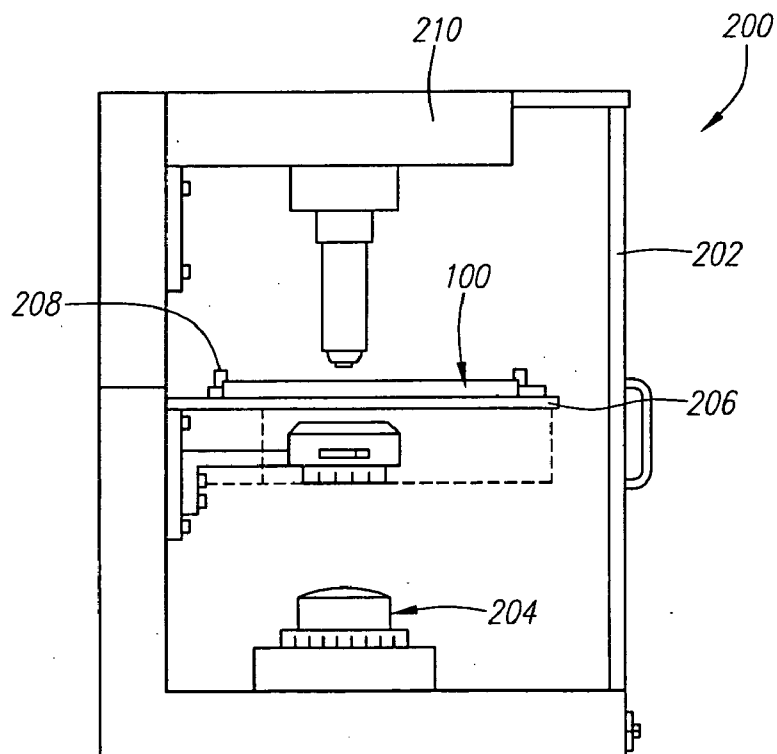


FIG. 9

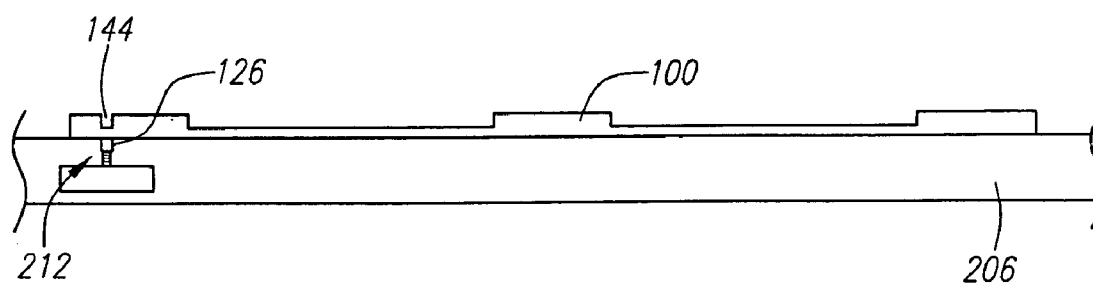


FIG. 10

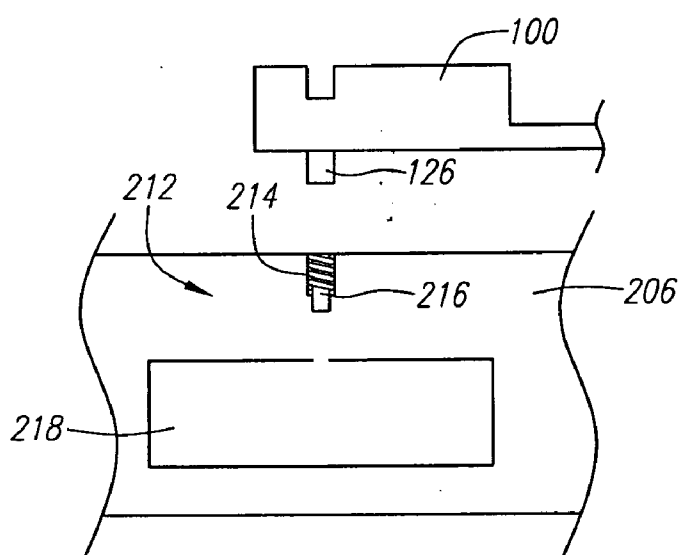


FIG. 11A

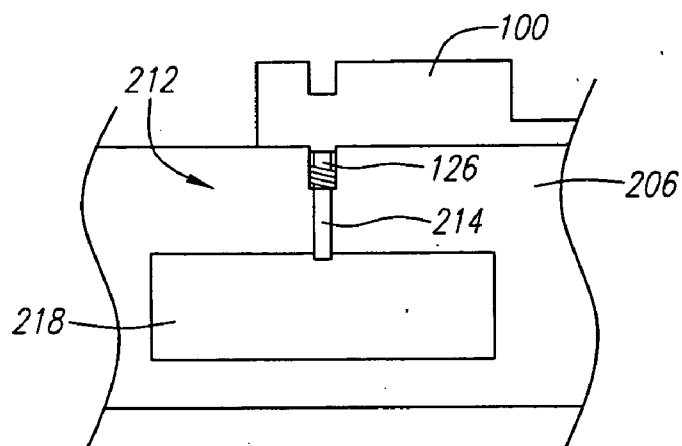


FIG. 11B

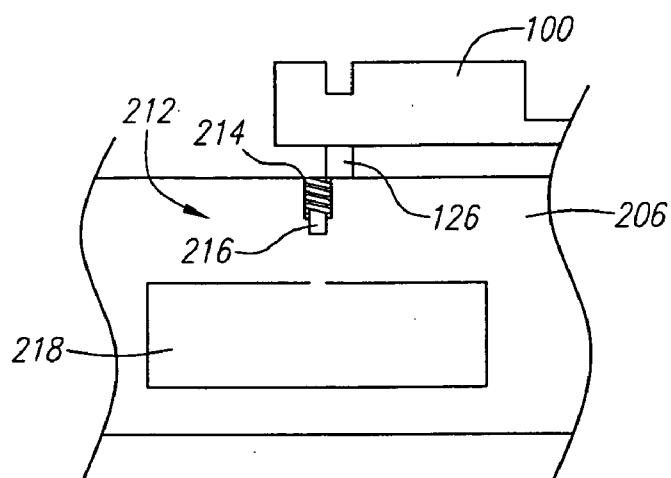


FIG. 12A

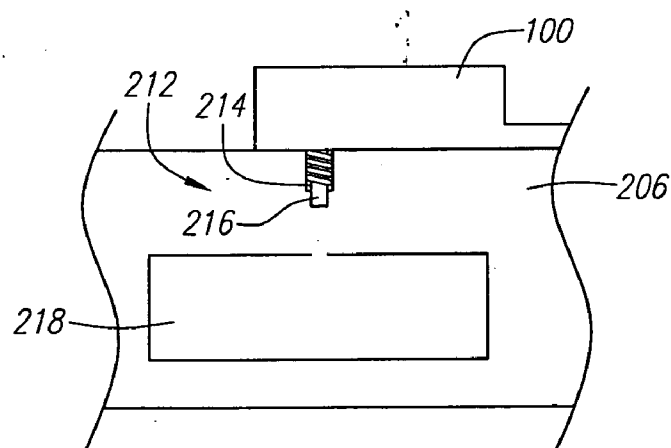


FIG. 12B

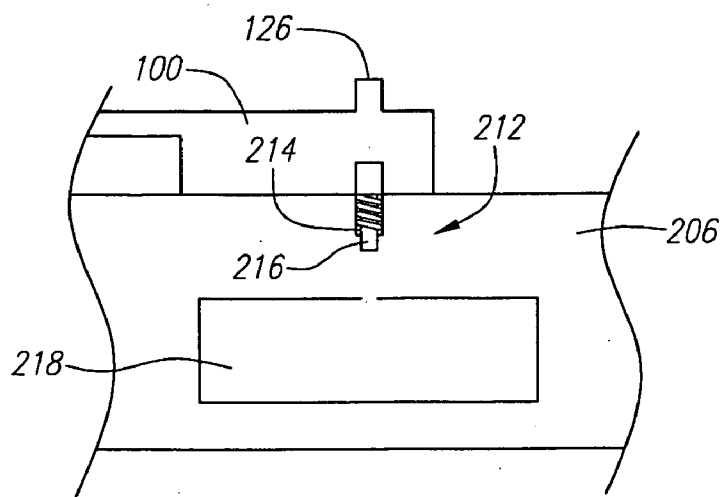


FIG. 12C

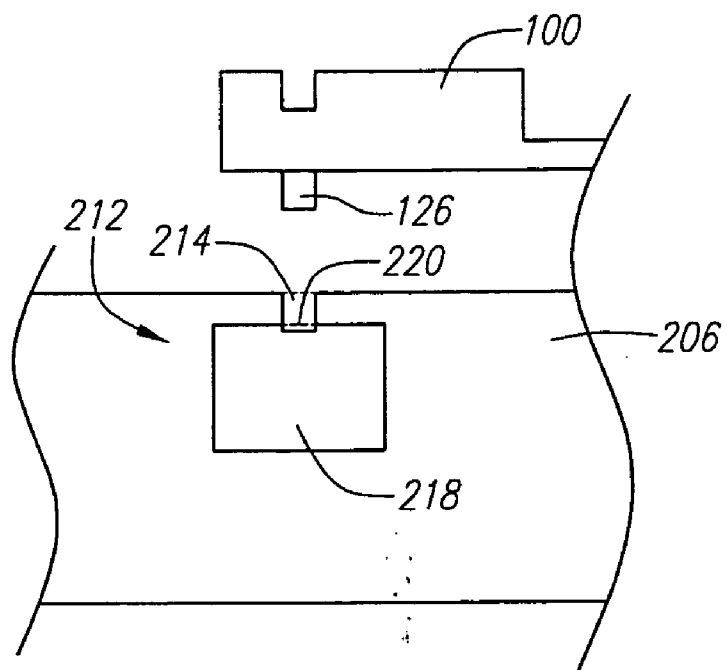


FIG. 13

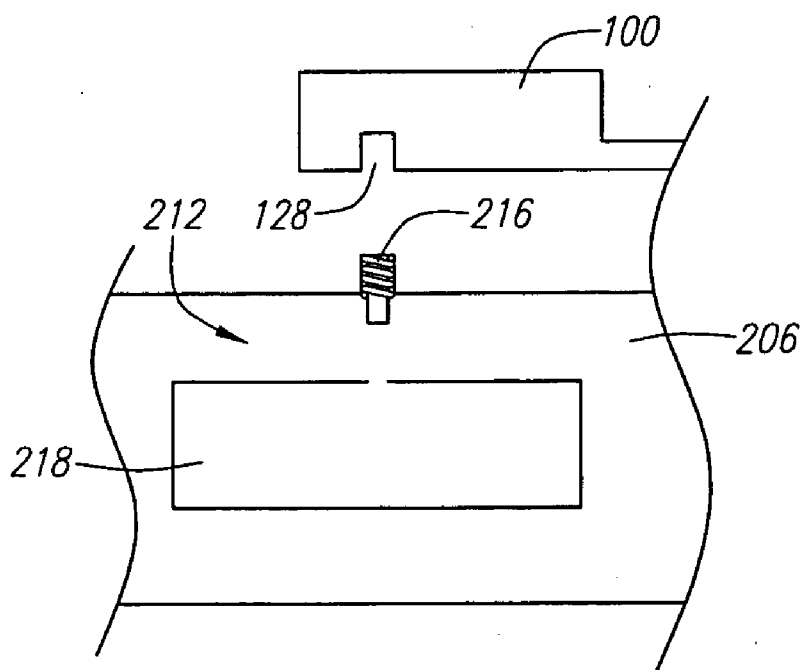


FIG. 14

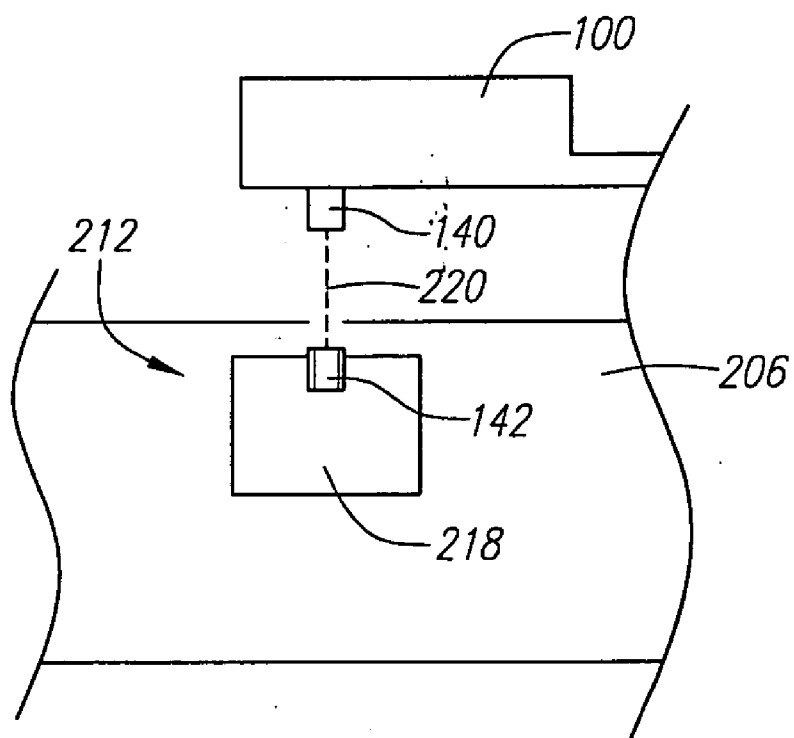


FIG. 15

SLIDE TRAY

FIELD OF INVENTION

[0001] The present invention generally relates to methods and devices for in imaging specimen slides, and more particularly, to devices and methods for loading a tray containing a plurality of slides into an imaging system, and for verifying the alignment and orientation of the tray in the imaging system.

DESCRIPTION OF RELATED ART

[0002] Various devices have been used to store glass slides, such as microscope and patient test slides. One known storage receptacle is a cardboard folder with recesses configured to hold slides. These folders have two flaps, which cover the recesses and hold the slides in place. These folders are typically used for archiving slides and also allow individual slides to be located with relative ease.

[0003] Another known storage receptacle is a slide cassette. A cassette typically includes a pair of fingers or support members with retaining members that extend from the cassette and below a slot. A slide is loaded into a slot and onto a pair of fingers. Each slot receives a single slide. The dimensions of a slot are typically larger than the dimensions of a slide so that the slide can be easily inserted into and removed from the slot.

[0004] Slide cassettes are often used with automated or semi-automated imaging systems. Automated or semi-automated imaging systems use robotic actuators or other devices to remove a slide from the cassette, process the slide or specimen, and return the slide into the cassette. For example, one device may acquire a slide from a cassette and position it beneath a microscope or other device so that a cytotechnologist can analyze the sample for cancer and other medical conditions. More specifically, the imaging system grasps the slide, lifts it above the retaining members of the fingers, removes the slide from the fingers and the slot, and positions the slide beneath the microscope or vision system. The imaging system re-inserts the slide into the cassette after the analysis is completed.

[0005] Transferring slides from the folders, in which they are stored, to cassettes, from which they are automatically loaded into slide imagers, is typically done by hand. Manual loading of slides, however, is time consuming and may lead to improper positioning of slides in cassettes. For example, a slide may not rest flat on the fingers. Instead, the slide may only partially clear one of the fingers and come to rest at an angle. Further, the slide can be inserted upside down so that the surface with a specimen sample is facing downward, whereas other slides may have their specimen samples facing upward. Further, slides can be twisted around. In other words, the slide may be inadvertently rotated 180 degrees. This may present a problem when, for example, a bar code or other data is present on one end of a slide.

[0006] Slides that are improperly positioned may also be broken by equipment that is programmed to select slides since the equipment is typically configured to select or re-insert a slide that is oriented in a particular manner. Thus, equipment errors and broken slides may result from misplaced slides. These errors may also result in system downtime while a cytotechnologist or technician is forced to examine the cassette and rearrange misplaced slides or replace broken slides.

SUMMARY OF THE INVENTION

[0007] In one embodiment, a tray for use with a slide imaging system, comprises a retainer and an aligning member, both disposed on a planar member. The planar member defines a recess for receiving a slide. The retainer secures the slide in the recess, and the aligning member enables an alignment and an orientation of the planar member in the slide imaging system to be verified.

[0008] In various embodiments, the retainer may be a leaf spring made from a resilient material or a planar cover configured to hold the slide on the planar member by compression. The retainer may be manually engaged, or it may be engaged by application of a cover to the planar member or insertion of the planar member into the slide imaging system.

[0009] In one embodiment, the aligning member is asymmetrically disposed on the planar member. In various embodiments, the aligning member may be a reflective marking, a projection, or a depression. Generally, the aligning member is configured to interact with the slide imaging system to verify the alignment and the orientation of the planar member, and to disable the slide imaging system if it cannot do so.

[0010] In one embodiment, the planar member defines an aperture, which provides a path through which light can pass to the slide disposed on the planar member. In another embodiment, the planar member defines a receptacle for receiving an aligning member disposed on a second tray, when the second tray is stacked on top of the tray.

[0011] In one embodiment, the tray comprises a plurality of retainers, which secure a plurality of slides into a plurality of recesses defined by the planar member. The tray may further comprise an actuator, wherein the actuator engages the plurality of retainers.

[0012] In accordance with another embodiment, a slide imaging system is provided with a light source, a stage disposed adjacent to the light source, one or more optical elements disposed adjacent to the stage, a tray holder disposed on the stage, and a slide tray affixed to the stage by the tray holder. The tray includes a retainer and an aligning member, both disposed on a planar member. The planar member defines a recess for receiving a slide. The retainer secures the slide in the recess, and the aligning member enables an alignment and an orientation of the planar member in the slide imaging system to be verified. The system may further comprise an enclosure surrounding the system.

[0013] The system may further comprise an alignment component, where the alignment component interacts with the aligning member to verify the alignment and the orientation of the slide tray on the stage, and to disable the slide imaging system if it cannot do so. In various embodiments, the alignment component may include an optical sensor, a switch, an electromechanical switch, or a light beam projector.

[0014] In yet another embodiment, a method of loading slides into an imaging system includes loading slides into a tray, retaining the slides on the tray with a resilient retainer, loading the tray into the imaging system, and verifying an alignment and an orientation of the slide tray in the slide

imaging system by placing an aligning member disposed on the tray in proximity to an alignment component disposed on the imaging system. The method may further comprise disabling the system if the system cannot verify the alignment and the orientation of the tray in the imaging system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] In order to better understand and appreciate the invention, reference should be made to the accompanying drawings, which illustrate exemplary embodiments thereof. In the drawings, similar elements are referred to by common reference numerals, and:

[0016] **FIG. 1** is a perspective view of a slide tray for loading a plurality of slides into a slide imaging system while verifying the alignment and orientation of the slides;

[0017] **FIGS. 2A-B** are detailed perspective views of the slide tray of **FIG. 1**, showing an individual recess without and with a slide loaded therein, respectively;

[0018] **FIG. 3** is a perspective view of a slide tray, according to another embodiment, for loading a plurality of slides into a slide imaging system while verifying the alignment and orientation of the slides;

[0019] **FIGS. 4A-B** are detailed perspective views of the slide tray of **FIG. 3** showing an individual recess without and with the retainer activated, respectively;

[0020] **FIG. 5** is a detailed perspective view of a slide tray, according to another embodiment, for loading a plurality of slides into a slide imaging system while verifying the alignment and orientation of the slides;

[0021] **FIG. 6** is a perspective view of a cover for use with the slide tray of **FIG. 5**;

[0022] **FIGS. 7A-B** are detailed perspective views of a slide tray, according to another embodiment, for loading a plurality of slides into a slide imaging system while verifying the alignment and orientation of the slides;

[0023] **FIG. 8** is a front view of a slide imaging system configured for use with a slide tray for loading a plurality of slides into a slide imaging system while verifying the alignment and orientation of the slides, with the front of the enclosure cut away;

[0024] **FIG. 9** is a side view of a slide imaging system of **FIG. 8**, with the side of the enclosure cut away;

[0025] **FIG. 10** is a cross sectional view through the line x-x in **FIG. 8**;

[0026] **FIGS. 11A-B** are detailed cross sectional views through the line x-x in **FIG. 8**;

[0027] **FIGS. 12A-C** are detailed cross sectional views through the line x-x in **FIG. 8**;

[0028] **FIG. 13** is a cross sectional view through the line x-x in **FIG. 8**, showing a slide tray and alignment component according to another embodiment;

[0029] **FIG. 14** is a cross sectional view through the line x-x in **FIG. 8**, showing a slide tray and alignment component according to another embodiment; and

[0030] **FIG. 15** is a cross sectional view through the line x-x in **FIG. 8**, showing a slide tray and alignment component according to another embodiment.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

[0031] In the following description of the illustrated embodiments, it will be understood by those skilled in the art that the drawings and specific components thereof are not necessarily to scale, and that various structural changes may be made without departing from the scope or nature of the various embodiments.

[0032] A slide tray and system are disclosed for storing slides and loading slides into a slide imaging system without manually transferring slides from a tray to a cassette. The tray includes recesses that are sized for holding a slide and leaf spring retainers in each recess that hold the slide in place through a friction fit mechanism. The tray also includes an aligning member, which is asymmetrically disposed on the bottom of the tray and interacts with an alignment component on the slide imaging system to verify the alignment and orientation of the tray in the imaging system. If the system cannot verify the alignment and orientation of the tray, the system is disabled. If the system verifies the alignment and orientation of the tray, the system is enabled. Additional details regarding the tray components and their operation follow.

[0033] Referring to **FIG. 1**, a slide tray **100** according to one embodiment includes a planar member **101** with a plurality of recesses **102** and a plurality of leaf spring retainers **104** disposed therein, extending from an inner surface **103**. The leaf spring retainers **104** secure slides **106** onto the slide tray **100** and, through a friction fit mechanism, prevent the slides **106** from falling out of the tray **100** or shifting within the recesses **102** when the tray **100** is moved. The slide tray **100** shown in **FIG. 1** has two columns of ten recesses **102** and can hold up to twenty slides **106**. Persons skilled in the art will appreciate that other numbers and arrangements of slides and slide trays can be used with different embodiments. Thus, the two by ten arrangement is shown for purposes of explanation and illustration, not limitation. The slide tray **100** also includes a plurality of apertures **108**, which are aligned with the specimen **110** disposed on the slide **106**. The apertures provide a path **112** through which light can pass. Thus, light can pass through the tray **100**, the slide **106** and the specimen **110**.

[0034] As shown in **FIG. 2A**, the tray **100** defines the recess **102** that approximates the shape and size of a slide **106**, and has a slightly longer length, which contains the leaf spring retainer **104**. The leaf spring retainer **104** is a thin, flat piece of plastic or metal that is curved and is capable of retaining a curved shape. One end of the leaf spring retainer **104** is connected to an inner surface of a tray **100** at a corner **114**, with the retainer **104** extending along a shorter side **116** of the recess **102**. The curved shape of the retainer **104** causes the middle of the retainer **104** to bulge outwardly towards the center of the recess **102**.

[0035] When a slide **106** is inserted into the recess **102**, as shown in **FIG. 2B**, the slide **106** depresses the retainer **104**, thus forcing the retainer **104** from its initially curved shape and into a more linear compressed shape. The retainer **104** has a resiliency so that the curved portion of the retainer **104**

presses against the side of the slide **106**, thus securing the slide **106** in the recess **102** using friction.

[0036] Referring to **FIGS. 3, 4A** and **4B**, another embodiment of a tray **100** includes an actuator **122**, which is a rigid “L” shaped member that is connected to the free end of retainer **104**. The actuator **122** can be, for example, metal or plastic. The retainer **104** also has a resiliency and a curved shape so that it tends to retain a slightly curved shape, as shown in **FIG. 4A**. The retainer **104** is connected to an inner surface of a tray **100** at a corner **114**, with the retainer **104** extending along a shorter side **116** of the recess **102**, as described above.

[0037] When a slide **106** is inserted into the recess **102** with the retainer **104** in its uncompressed, slightly curved shape, there is a space **130** between the retainer **104** and the slide **106**. When the actuator **122** is moved forward towards the corner **114** of the inner surface of the tray **100** where the retainer **104** is connected, as shown in **FIG. 4B**, the motion compresses the retainer **104**, causing it to curve into the recess **102** and towards the slide **106**, until it presses against the slide **106**, thereby holding the slide **106** in the recess **102** using friction.

[0038] In the embodiment shown in **FIG. 3**, a plurality of actuators **122** are connected together so that one movement of the actuators **122** compresses a plurality of retainers **104**. Also, an actuator lock **132** holds the actuators **122** in the forward position and the retainers **104** in the compressed state, until the actuator lock **132** is released. Alternatively, the actuators **122** and the retainers **104** to which they are attached can be activated by insertion of the tray **100** into a slide imaging system (not shown).

[0039] Referring to **FIGS. 5** and **6**, in another embodiment, the actuator **122** is a wedge **134** that is connected to the free end of the retainer **104**. When an opposing wedge **136**, connected to a cover **118**, is lowered onto the wedge **134**, the wedge **134** and the free end of the retainer **104** are moved towards the corner **114** of the recess **102** where the retainer **104** is connected. This motion compresses the retainer **104**, causing it to curve into the recess **102** towards the slide **106** until it presses against the slide **106**, holding the slide **106** in the recess **102** using friction. The retainers **104** are arrayed on the tray **100** in the two by ten pattern described above. The twenty actuators **122** on the tray **100** can be activated simultaneously by attaching, from above, a cover **118** with twenty opposing wedges **136** positioned thereon, as shown in **FIG. 6**.

[0040] Persons skilled in the art will appreciate that other retainers can be utilized. For example, referring to **FIGS. 7A** and **7B**, another embodiment of a retainer is a cover **118** with windows **120** positioned to maintain the light path **112** through a tray **100** when the cover **118** is applied to the tray **100**. The windows **120** have slightly less length and width than a slide **106**. The tray **100** defines recesses **102** having slightly less depth than the thickness of the slide **106**. Because the window **120** is slightly smaller than the slide **106**, closing the cover **118** holds the slide **106** in place in the recess **102** with a compression fit. The cover **118** and the tray **100** are connected with hinges **124** to ensure proper placement of the cover **118** on the tray **100** to define the light path **112**.

[0041] Referring to **FIGS. 8** and **9**, an embodiment of a slide imaging system **200** generally includes an enclosure

202, a light source **204**, a movable precision stage **206**, a slide tray **100** affixed to the stage **206** by a slide tray holder **208**, and an optical element **210**. The slide tray **100** may be one of the slide trays shown in **FIGS. 1, 3, 6** and **7A-B**.

[0042] Referring to **FIGS. 10, 11A** and **11B**, the slide imaging system **200** also includes an alignment component **212**, which interacts with an aligning projection **126** on a tray **100** to verify the alignment and orientation of the tray **100** in the system **200**. The alignment component **212** is located on the stage **206** and includes a receiver **214** for the aligning projection **126**, a spring loaded switch **216** inside of the receiver **214** and a breaker circuit **218**. The spring loaded switch **216** is biased in the position where the switch does not complete the circuit **218**, as shown in **FIG. 11A**. When the tray **100** is properly placed on the stage **206**, the aligning projection **126** sits in the receiver **214** and depresses the switch **216**, which compresses the spring and completes the circuit **218**, as shown in **FIG. 11B**, thus allowing the slide imaging system **200** to operate. The top side of the tray **100** includes a receptacle **144**, that receives the alignment projection **126** of a second tray when the second tray is stacked on top of the exemplary tray **100**.

[0043] Referring to **FIGS. 1** and **10**, the aligning projection **126** is asymmetrically disposed on the bottom of the tray **100**. Therefore, if the tray is misaligned, as in **FIG. 12A**, the aligning projection **126** will not activate the switch **216** to complete the circuit **218** and activate the system **200**. Similarly, if the tray is rotated 180 degrees or flipped upside down, the aligning projection **126** will not activate the switch **216**, as shown in **FIGS. 12B** and **12C**, respectively. In this way, the aligning projection **126** and alignment component **212** not only verify the alignment of the tray **100** in the system **200**, but also the rotational orientation of the tray **100** relative to the system **200**.

[0044] Persons skilled in the art will appreciate that other alignment components **212** can be utilized with the aligning projection **126** described above. For example, referring to **FIG. 13**, another embodiment of an alignment component **212** includes a light beam **220**, which is broken by insertion of the aligning projection **126** into the receiver to activate the system **200**.

[0045] Persons skilled in the art will appreciate that other alignment mechanisms can be utilized to verify the alignment and orientation of a tray **100** in an imaging system **200**. For example, as shown in **FIG. 14**, an alternative embodiment of a tray **100** includes an aligning hole **128**, and an alternative embodiment of an imaging system **200** includes a stage **206** with a spring loaded switch **216**. When depressed, the switch **216** causes an alignment component **212** to disable the system **200** by completing a circuit **218**. The aligning hole **128** allows the tray **100** to be placed on the stage **206** without depressing the spring loaded switch **216** and disabling the system **200**. If the tray **100** is placed on the stage **206** and the aligning hole **128** is not aligned with the spring loaded switch **216**, the circuit **218** will be completed and the system **200** will be disabled. In this way, the combination of the aligning hole **128** and the alignment component **212** with the spring loaded switch **216** verifies the alignment of the tray **100** in the system **200** and the rotational orientation of the tray **100** relative to the system **200** as described above.

[0046] Persons skilled in the art will appreciate that a tray **100** can also include an aligning reflector **140**, as shown in

FIG. 15, which reflects a light beam from an alignment component **212** that is detected by an optical sensor **142** to activate the system **200**.

[0047] Although various embodiments of the invention have been shown and described herein, it should be understood that the above description and figures are not intended to be limiting, and that the invention is defined only by the appended claims and their equivalents.

What is claimed:

1. A tray for use with a slide imaging system, the tray comprising:

a planar member, the planar member defining a recess for receiving a slide;

a retainer; and

an aligning member, wherein the retainer and the aligning member are both disposed on the planar member, the retainer secures the slide in the recess, and the aligning member enables verification of an alignment and an orientation of the planar member in the slide imaging system.

2. The tray of claim 1, wherein the retainer is a leaf spring.

3. The tray of claim 1, wherein the retainer is made from a resilient material.

4. The tray of claim 1, wherein the retainer is a planar cover.

5. The tray of claim 4, where the planar cover is configured to hold the slide on the planar member by compression.

6. The tray of claim 1, wherein the retainer is manually engaged.

7. The tray of claim 1, further comprising a cover, wherein the retainer is engaged by application of the cover to the planar member.

8. The tray of claim 1, wherein the retainer is engaged by insertion of the planar member into the slide imaging system.

9. The tray of claim 1, wherein the aligning member is asymmetrically disposed on the planar member.

10. The tray of claim 1, wherein the aligning member is a reflective marking.

11. The tray of claim 1, wherein the aligning member is a projection.

12. The tray of claim 1, wherein the aligning member is a depression.

13. The tray of claim 1, wherein the aligning member is configured to interact with the slide imaging system to verify the alignment and the orientation of the planar member.

14. The tray of claim 1, wherein the aligning member is configured to interact with the slide imaging system to disable the slide imaging system if the slide imaging system cannot verify the alignment and the orientation of the planar member.

15. The tray of claim 1, wherein the planar member defines an aperture, the aperture providing a path through which light can pass to a slide disposed on the planar member.

16. The tray of claim 1, the planar member defining a receptacle for receiving an aligning member disposed on a second tray, the second tray being stacked on top of the tray.

17. The tray of claim 1, further comprising a plurality of retainers that secure an associated plurality of slides into a respective plurality of recesses defined by the planar member.

18. The tray of claim 17, further comprising an actuator that engages the plurality of retainers.

19. A slide imaging system, comprising:

a light source;

a stage disposed adjacent to the light source;

one or more optical elements disposed adjacent to the stage;

a tray holder disposed on the stage; and

a slide tray affixed to the stage by the tray holder, the tray including

a planar member defining a recess for receiving a slide, a retainer, and

an aligning member, wherein the retainer and the aligning member are both disposed on the planar member, the retainer secures the slide in the recess, and the aligning member enables verification of an alignment and an orientation of the planar member in the slide imaging system.

20. The system of claim 19, further comprising an enclosure substantially surrounding the system.

21. The system of claim 19, further comprising an alignment component that interacts with the aligning member to verify the alignment and the orientation of the slide tray on the stage.

22. The system of claim 21, wherein the alignment component includes an optical sensor.

23. The system of claim 21, wherein the alignment component includes a switch.

24. The system of claim 23, wherein the switch is an electromechanical switch.

25. The system of claim 21, wherein the alignment component includes a light beam projector.

26. The system of claim 21, wherein the alignment component is configured to interact with the aligning member to disable the system if the system cannot verify the alignment and the orientation of the slide tray on the movable stage.

27. A method of loading slides into an imaging system, comprising:

loading slides into a tray;

retaining the slides on the tray with a resilient retainer;

loading the tray into the imaging system; and

verifying an alignment and an orientation of the slide tray in the slide imaging system by placing an aligning member disposed on the tray in proximity to an alignment component disposed on the imaging system.

28. The method of claim 27, further comprising disabling the system if the system cannot verify the alignment and the orientation of the tray in the imaging system.

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