DRIP CHAMBER WITH INTEGRATED OPTICS

TECHNICAL FIELD

[0001] The present disclosure relates to a rectangular drip chamber for an infusion tube with integrated optics, in particular, lenses integrated onto one or more walls of the drip chamber. The present disclosure relates to an optical imaging system including the rectangular drip chamber for the infusion tube with integrated optics.

BACKGROUND

[0002] It is known to use lenses, separate from a cylindrical drip chamber, as part of an optical imaging system for an infusion tube. Source light and imaging light must pass through the cylindrical wall of the drip chamber when entering and exiting the drip chamber, respectively, greatly complicating the optical design of both the illumination and imaging sub-systems (lenses, image sensors etc.).

SUMMARY

[0003] According to aspects illustrated herein, there is provided a drip chamber for an infusion tube, including: a first end arranged to receive a drip tube; a second end including an exit port; at least one wall connecting the first and second ends, wherein said at least one wall includes a code integral to the at least one wall, the code including information regarding the drip chamber; a space enclosed by the first and second ends and the at least one wall; and first and second lenses each directly fixed to said at least one wall.~~;~~ In one embodiment, there is provided a space enclosed by the first and second ends and the at least one wall; and at least one lens integral to the at least one wall or directly fixed to the at least one wall.

[0004] According to aspects illustrated herein, there is provided an optical imaging system for use with an infusion device, including: at least one light source for emitting first light; a drip chamber including at least one wall connecting first and second ends of the drip chamber and a space at least partially enclosed by the at least one wall and the first and second ends, and first and second lenses each directly fixed to the at least one wall, said first and second lenses each arranged to transmit the first light to the space or receive the first light transmitted through the space, wherein said at least one wall includes a code integral to the at least one wall, the code including information regarding the drip chamber; an optics system including at least one image sensor for receiving the

first light from said first and second lenses and transmitting data characterizing the first light received from said first and second lenses; and at least one specially programmed processor configured to generate at least one image of the space using the data. ~~and~~In an embodiment, there is provided at least one lens integral to the at least one wall or directly fixed to the at least one wall, the at least one lens arranged to: transmit the first light to the space or receive the first light transmitted through the space. The imaging system includes an optics system including at least one image sensor for receiving the first light from the at least one lens and transmitting data characterizing the first light received from the at least one lens; and at least one specially programmed processor configured to generate, using the data, at least one image of the space.

[0005] According to aspects illustrated herein, there is provided a drip chamber for an infusion tube, including: a first end arranged to receive a drip tube; a second end including an exit port; and first, second, third, and fourth walls connecting the first and second ends. In a cross-section orthogonal to a longitudinal axis for the drip tube, the first, second, third, and fourth walls form a rectangle enclosing a space, wherein one of said first, second, third and fourth walls includes a code integral to said one of said first, second, third and fourth walls, the code including information regarding the drip chamber; and first and second lenses each directly fixed to one of said first, second, third and fourth walls.

[0006] According to aspects illustrated herein, there is provided a method of forming a drip chamber for an infusion tube, including: forming a first end arranged to receive a drip tube; forming a second end including an exit port; connecting the first and second ends with at least one wall; integrally attaching a code to the at least one wall, the code including information regarding the drip chamber; and directly fixing first and second lenses to the at least one wall.~~enclosing~~ In one embodiment, there is provided a space enclosed with the first and second ends and the at least one wall; and integrating at least one lens into the at least one wall; or directly fixing at least one lens to the at least one wall.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Various embodiments are disclosed, by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, in which:

Figure 1 is a schematic side view of an optical imaging system with a rectangular drip chamber;

Figure 2 is a schematic top view of an optical imaging system with a square drip chamber;

Figure 3 is a schematic side view of an optical imaging system with a drip chamber including at least one integrated or directly fixed lens;

Figure 4 is a schematic top view of an optical imaging system with a drip chamber including at least one integrated or directly fixed lens;

Figure 5 is a schematic side view of an optical imaging system with a drip chamber including at least one integrated or directly fixed lens; and

Figure 6 is a schematic top view of an optical imaging system including at least one integrated or directly fixed lens.

DETAILED DESCRIPTION

[0008] At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical, or functionally similar, structural elements of the disclosure. It is to be understood that the disclosure as claimed is not limited to the disclosed aspects.

[0009] Furthermore, it is understood that this disclosure is not limited to the particular methodology, materials and modifications described and as such may, of

~~CLAIMS~~

~~1. A drip chamber for an infusion tube, comprising:~~

~~a first end (104, 204, 304) arranged to receive a drip tube (106, 206, 306);~~

~~a second end (108, 208, 308) including an exit port (110, 210, 310);~~

~~at least one wall (112, 212, 312) connecting the first and second ends;~~

~~a space (120, 220, 320) enclosed by the first and second ends and the at least one wall; and,~~

~~at least one lens (121, 221, 321) integral to the at least one wall or directly fixed to the at least one wall.~~

~~2. The drip chamber of claim 1, wherein the at least one lens is arranged to:~~

~~transmit light to the space; or,~~

~~receive light transmitted through the space.~~

~~3. The drip chamber of claim 1, wherein:~~

~~the at least one wall includes a first wall (216) with at least a flat portion (216A, 216B); and,~~

~~the at least one lens (221A, 221B) is integral to the flat portion or is directly fixed to the flat portion.~~

~~4. The drip chamber of claim 1, wherein:~~

~~the at least one wall (216, 316) includes an exterior surface (250, 350); and,~~

~~the at least one lens (221, 321) is integral to the exterior surface or is directly fixed to the exterior surface.~~

~~5. The drip chamber of claim 1, wherein:~~

~~the at least one wall includes first and second walls (212, 216) with at least first and second flat portions (216B, 216B), respectively, substantially parallel to each other; and,~~

~~the at least one lens (221A, 221B) is integral to one only of the first or second walls (212, 216) or is directly fixed to one only of the first or second flat portions.~~

6. The drip chamber of claim 1, wherein the at least one wall (112, 114, 116, 118) forms a rectangle enclosing the space (120) in a cross-section orthogonal to a longitudinal axis of the drip chamber.

7. The optical imaging system of claim 1, wherein:

the at least one lens includes first and second lenses (221A, 221B);

the at least one wall includes first and second walls (212, 216) with at least first and second flat portions (216A, 216B), respectively;

the first lens (221A) is integral to the first flat portion (216A) or is directly fixed to the first flat portion; and,

the second lens (221A) is integral to the second flat portion (216B) or is directly fixed to the second first flat portion.

8. The optical imaging system of claim 7, wherein a longitudinal axis for the drip chamber is located between the first and second lenses on a line connecting the first and second lenses.

9. The optical imaging system of claim 1, wherein:

the at least one wall includes a code integral to the at least one wall; and,

the code includes information regarding the drip chamber.

10. An optical imaging system for use with an infusion device, comprising:

at least one light source (122,222) for emitting first light;

a drip chamber including:

at least one wall (112, 212, 312) connecting first and second ends (104, 108) of the drip chamber; and,

a space (120, 220) at least partially enclosed by the at least one wall and the first and second ends; and,

at least one lens (124, 224, 324) integral to the at least one wall or directly fixed to the at least one wall, the at least one lens arranged to:

transmit the first light to the space; or,

receive the first light transmitted through the space;

an optics system (123, 223, 323) including at least one image sensor (126, 226, 326) for:

receiving the first light from the at least one lens; and,

transmitting data characterizing the first light received from the at least one lens; and,

at least one specially programmed processor (135, 235, 335) configured to generate, using the data, at least one image of the space.

11. The optical imaging system of claim 10, wherein:

the at least one wall includes an exterior surface (250, 350); and,

the at least one lens includes a first lens (224, 324) integral to the exterior surface or directly fixed to the exterior surface.

12. The optical imaging system of claim 10, wherein:

the at least one wall includes a first wall (216) with at least a flat portion (216A); and,

the at least one lens is integral to the flat portion or is directly fixed to the flat portion.

13. The optical imaging system of claim 10, wherein:

the at least one lens includes first (221) and second lenses (224);

the first lens (221) is arranged to transmit the first light to the space; and,

the second lens (224) is arranged to:

receive the first light transmitted by the first lens through the space; and,

transmit the received first light to the at least one image sensor.

14. The optical imaging system of claim 10, wherein:

an end of the drip tube (106, 206, 306) is located in the space (120, 220);

the image includes an image of a drop pendant from the end of the drip tube; and,

the at least one specially programmed processor is configured to calculate a volume of the pendant drop from the image.

15. The optical imaging system of claim 10, wherein:

a meniscus for fluid in the drip chamber is located in the space; and,

the at least one specially programmed processor (135, 235, 335) is configured to calculate, from the image, a position of the meniscus within the drip chamber.

16. The optical imaging system of claim 10, wherein:

the at least one wall includes a code integral to the at least one wall; and,

the code includes information regarding the drip chamber.

17. A drip chamber for an infusion tube, comprising:

a first end (104) arranged to receive a drip tube (106);

a second end (108) including an exit port (110); and,

first, second, third, and fourth walls (112, 114, 116, 118) connecting the first and second ends, wherein, in a cross-section orthogonal to an longitudinal axis for the drip tube, the first, second, third, and fourth walls form a rectangle enclosing a space (120).

18. A method of forming a drip chamber for an infusion tube, comprising:

forming a first end arranged to receive a drip tube;

forming a second end including an exit port;

connecting the first and second ends with at least one wall;

enclosing a space with the first and second ends and the at least one wall; and,

integrating at least one lens into the at least one wall; or,

directly fixing at least one lens to the at least one wall.

CLAIMS

The invention claimed is:

1. A drip chamber for an infusion tube, comprising:
a first end arranged to receive a drip tube;
a second end including an exit port;
at least one wall connecting the first and second ends, wherein said at least one wall includes a code integral to the at least one wall, the code including information regarding the drip chamber;
a space enclosed by the first and second ends and the at least one wall; and
first and second lenses each directly fixed to said at least one wall.

2. The drip chamber of claim 1, wherein said first and second lenses are each arranged to:
transmit light to the space or receive light transmitted through the space.

3. The drip chamber of claim 1, wherein:
the at least one wall includes a first wall with at least a flat portion and the said first and second lenses are directly fixed to the flat portion.

4. The drip chamber of claim 1, wherein the at least one wall includes an exterior surface and said first and second lenses are directly fixed to the exterior surface.

5. The drip chamber of claim 1, further comprising first and second walls with at least first and second flat portions, respectively, substantially parallel to each other, wherein said first and second lenses are directly fixed to only one of the first or second flat portions.

6. The drip chamber of claim 1, wherein the at least one wall forms a rectangle enclosing the space in a cross-section orthogonal to a longitudinal axis of the drip chamber.

7. The drip chamber of claim 1, further comprising first and second walls with at least first and second flat portions, respectively;

the first lens is directly fixed to the first flat portion and the second lens is directly fixed to the second first flat portion.

8. The drip chamber of claim 7, wherein a longitudinal axis for the drip chamber is located between the first and second lenses on a line connecting the first and second lenses.

9. An optical imaging system for use with an infusion device, comprising:
at least one light source for emitting first light;
a drip chamber including at least one wall connecting first and second ends of the drip chamber, a space at least partially enclosed by the at least one wall and the first and second ends, and first and second lenses each directly fixed to the at least one wall, said first and second lenses each arranged to transmit the first light to the space or receive the first light transmitted through the space, wherein said at least one wall includes a code integral to the at least one wall, the code including information regarding the drip chamber;
an optics system including at least one image sensor for receiving the first light from said first and second lenses and transmitting data characterizing the first light received from said first and second lenses; and
at least one specially programmed processor configured to generate at least one image of the space using the data.

10. The optical imaging system of claim 9, wherein the at least one wall includes an exterior surface and the said first and second lenses are directly fixed to the exterior surface.

11. The optical imaging system of claim 9, wherein the at least one wall includes at least a flat portion and said first and second lenses are directly fixed to the flat portion.

12. The optical imaging system of claim 9, wherein the first lens is arranged to transmit the first light to the space and the second lens is arranged to receive the first light transmitted by the first lens through the space and transmit the received first light to the at least one image sensor.

13. The optical imaging system of claim 9, wherein the drip chamber includes a drip tube, an end of the drip tube is located in the space, the at least one image including an image of a drop pendant from the end of the drip tube and the at least one specially programmed processor is configured to calculate a volume of the pendant drop from the image of the drop pendant.

14. The optical imaging system of claim 9, wherein a meniscus for fluid in the drip chamber is located in the space and the at least one specially programmed processor is configured to calculate, from the at least one image, a position of the meniscus within the drip chamber.

15. A drip chamber for an infusion tube, comprising:
a first end including a drip tube;
a second end including an exit port;
first, second, third, and fourth walls connecting the first and second ends, wherein, in a cross-section orthogonal to a longitudinal axis of the drip tube, the first, second, third, and fourth walls form a rectangle enclosing a space, wherein one of said first, second, third and fourth walls includes a code integral to said one of said first, second, third and fourth walls, the code including information regarding the drip chamber; and
first and second lenses each directly fixed to one of said first, second, third and fourth walls.

16. A method of forming a drip chamber for an infusion tube, the method comprising:
forming a first end arranged to receive a drip tube;
forming a second end including an exit port;
connecting the first and second ends with at least one wall and enclosing a space with the first and second ends and the at least one wall;
integrally attaching a code to the at least one wall, the code including information regarding the drip chamber; and directly fixing first and second lenses to the at least one wall.