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SYSTEMS AND METHODS FOR CATHETER RESTORATION

Abstract

A system for removing kinks in a catheter and/or reforming a catheter of a medical device is provided. The system can include at least one clamp, a heat device, and a pair of rolling wheels. In at least one example, the at least one clamp can be operable to secure the catheter. In some examples, the heat device can be operable to provide heat to the catheter. In some examples, the pair of rolling wheels can be operable to receive the catheter of the medical device therebetween such that when the catheter is moved along a longitudinal axis between the pair of rolling wheels, the pair of rolling wheels reforms the catheter.

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Background/Summary

FIELD

[0001] The present disclosure is directed to systems and methods for reforming a catheter of a medical device.

BACKGROUND

[0002] In many instances, reprocessing medical devices can provide cost efficient alternatives to newly manufactured medical devices. For example, devices that are reprocessed can have the same functionality as an originally manufactured medical device at a fraction of the cost. However, significant care must be taken when reprocessing medical devices to ensure that the reprocessed device has the same functionality as the originally manufactured device.

[0003] For medical devices with catheters, the catheter can become deformed during use or during post-use storage. In other examples, the catheter could be deformed due to a manufacturing defect, improper handling, or improper use. Therefore, there is a need for a catheter restoration system and methods for reforming catheters that have kinks and/or other defects in order to fully reprocess the catheters.

SUMMARY

[0004] Provided herein is a system for removing kinks in a catheter of a medical device and/or reforming the catheter of the medical device. The system can include at least one clamp operable to secure the catheter, a heat device operable to provide heat to the catheter secured by the at least one clamp, and a reforming assembly. In at least one example, the reforming assembly can include a reforming component operable to receive the catheter of the medical device therein such that when the catheter is moved along a longitudinal axis through the reforming assembly, the reforming assembly reforms the catheter. In some examples, the system can further include a medical device tray operable to hold the medical device. In some examples, the reforming assembly includes a pair of rolling wheels. In some examples, the reforming component includes a groove formed along a circumference of each wheel of the pair of wheels. In some examples, the grooves are operable to contact an exterior surface of the catheter and reform the exterior surface of the catheter. In at least one example, at least one wheel of the pair of rolling wheels can have an adjustable vertical position. In at least one example, the system can include one or more additional pairs of rolling wheels.

[0005] In at least on example, the heat device is operable to provide heated air to the catheter at a temperature of about 55 degrees C. to about 170 degrees C. In some examples, the heated air is operable to soften the catheter of the medical device. In at least one example, the system can further include at least one guide rail. In some examples, the at least one clamp can be slidably coupled to the at least one guide rail. In some examples, the at least one clamp can include a first clamp and a second clamp.

[0006] In at least one example, the system can further include a processor and a display. In some examples, the processor can be configured to receive one or more inputs from an operator, display one or more instructions to the operator via the display, and cause the heat device to provide heated air to the catheter. In some examples, the one or more instructions can include one or more of choose recipe, cooling in progress, remove medical device, and confirm medical device restoration.

[0007] Further provided herein is a method for reforming a catheter of a medical device. The method can include placing a body of a medical device in a medical device tray, securing the catheter to one or more clamps, providing heated air to at least one kink in the catheter via a heat device, receiving the catheter in a reforming component of a reforming assembly, moving the catheter along a longitudinal axis through the reforming assembly, and cooling the catheter. In at least one example, providing heated air to the at least one kink in the catheter can soften a material of the catheter. In at least one example, moving the catheter along a longitudinal axis through the reforming assembly reforms the catheter. In at least one example, the heated air can have a temperature of about 55 degrees C. to about 170 degrees C. In some examples, the heated air is provided for about 5 seconds to about 20 seconds. In some examples, the method can further include inspecting the catheter. In some examples, the method can further include repeating the method if the catheter is not fully restored to a desired shape. In at least one example, the method can further include sterilizing the medical device. In at least one example, each wheel of the pair of wheels can have a groove for receiving the catheter. In at least one example, the reforming assembly includes a pair of rolling wheels. In some examples, the reforming component includes a groove formed along a circumference of each wheel of the pair of wheels.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Details of one or more aspects of the subject matter described in this disclosure are set forth in the accompanying drawings and the description below. However, the accompanying drawings illustrate only some typical aspects of this disclosure and are therefore not to be considered limiting of its scope. Other features, aspects, and advantages will become apparent from the description, the drawings and the claims.

[0009] FIG. **1** illustrates a system for catheter reformation;

[0010] FIG. **2** illustrates the system for catheter reformation;

[0011] FIG. **3** illustrates the system for catheter reformation;

[0012] FIG. **4** illustrates a wheel;

[0013] FIG. **5** illustrates a wheel assembly;

[0014] FIG. **6** illustrates a clamp assembly;

[0015] FIG. **7** illustrates a catheter reformation system;

[0016] FIG. **8** illustrates a medical device body support;

[0017] FIG. **9** illustrates a catheter reformation system;

[0018] FIGS. **10**A-**10**F illustrate various instructions, statuses, and warnings displayed on a display screen;

[0019] FIG. **11** illustrates another example of a catheter restoration system;

[0020] FIGS. **12**A-**12**C illustrate an example of a split-mold reforming assembly;

[0021] FIG. **13** is a schematic diagram of a controller; and

[0022] FIG. **14** illustrates a flow chart of a method for restoring kinks in a catheter and/or reforming a catheter.

DETAILED DESCRIPTION

[0023] It will be appreciated that for simplicity and clarity of illustration, where appropriate, reference numerals have been repeated among the different figures to indicate corresponding or analogous elements. In addition, numerous specific details are set forth in order to provide a thorough understanding of the examples described herein. However, it will be understood by those of ordinary skill in the art that the examples described herein can be practiced without these specific details. In other instances, methods, procedures and components have not been described in detail so as not to obscure the related relevant feature being described. Also, the description is not to be considered as limiting the scope of the embodiments described herein. The drawings are not necessarily to scale and the proportions of certain parts may be exaggerated to better illustrate details and features of the present disclosure.

[0024] Several definitions that apply throughout the above disclosure will now be presented.

[0025] The term "coupled" as used herein is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The connection can be such that the objects are permanently connected or releasably connected.

[0026] The term "substantially" is defined to be essentially conforming to the particular dimension, shape or other word that substantially modifies, such that the component need not be exact.

[0027] The term “about” means reasonably close to the particular value. For example, about does not require the exact measurement specified and can be reasonably close. For example, the term “about” can include the number plus-or-minus 30%. In some examples, the word “about” can include the exact number.
[0028] The terms “comprising,” “including” and “having” are used interchangeably in this disclosure. The terms “comprising,” “including” and “having” mean to include, but not necessarily be limited to the things so described.
[0029] The present disclosure relates to a catheter restoration system and methods operable to remove kinks and/or reform a catheter of a medical device. The system is operable to remove kinks from catheters that were previously used in a patient or catheters that have manufacturing defects from the original manufacture of the device. Further, the system can reform catheters back to an as-manufactured condition and/or within medical grade tolerances for use in a patient. The system can include a heat device operable to soften the kinked or damaged material of the catheter and a reforming assembly operable to reform the kinked or damaged material to a uniform and consistent diameter.
[0030] FIG. **1** illustrates the catheter restoration system **100**. The catheter restoration system **100** can be operable to reform a kinked or damaged surface of a catheter **232** of a medical device **702**. The medical device **702** can be a medical device **702** with a catheter **232**, as illustrated, for example in FIGS. **7-9**. The medical device **702** can be any type of medical device **702** that includes a catheter **232**. For example, the medical device **702** could be an imaging catheter (e.g., ultrasound imaging catheters). In some examples, the medical device **702** can have a body **704**, as illustrated, for example, in FIGS. **7-9**. In some examples, the medical device **702** can have a catheter **232**, as illustrated, for example, in FIGS. **2**, **3**, **7**, **8**, and **9**. The catheter restoration system **100** can be operable to heat an exterior surface of a catheter **232** via a heating device **114**, as illustrated for example, in FIGS. **1**, **2**, **3**, **7**, and **11**. The heat device **114** can be operable to provide heat to the catheter **232** such that the exterior surface of the catheter **232** softens. Softening the exterior surface of the catheter **232** can allow for the catheter to become moldable (e.g., the form or shape of the exterior surface of the catheter **232** can be changed). For example, the softened or moldable exterior surface can be formed into a desired shaped by applying a pressure or force to the exterior surface. The pressure or force can be applied by a reforming assembly **109** operable to shape or mold the softened material into a desired shape (e.g., a consistent diameter). The pressure or force can be provided by a pair of rolling wheels (e.g., first wheel assembly **110** and/or second wheel assembly **112**), as illustrated, for example, in FIGS. **1**, **2**, **3**, **5** or by a reforming split mold **1213**, as illustrated for example, in FIGS. **12**A-**12**C.
[0031] Reforming the catheter **232** to a desired shape (e.g., a consistent diameter) can allow the catheter to be reused in a patient. In some examples, the catheter **232** has been used in a patient previously and has been damaged (e.g., kinked). Damaged catheters with non-uniform diameters are unsafe for patient use because damaged catheters can have protrusions or indents which can damage arteries of a patient. By reforming the catheter **232**, protrusions or indents in the catheter **232** can be removed, thereby providing a catheter **232** with a consistent uniform surface that is safe for patient use. For example, the catheter **232** can be reformed to an originally manufactured and clinically safe condition.
[0032] The catheter restoration system **100** can include a medical device tray **102** operable to hold the body **704** of the medical device **702**. The medical device tray **102** can provide a stable surface for holding the medical device **702**, thereby preventing unwanted motion of the medical device **702** such as rolling, rotation, tipping, or other unwanted motion. The medical device tray **102** can also provide for precise control over the movement of the medical device **702** such as translating the medical device **702** throughout the system. In some examples, the medical device tray **102** can include a V-shaped tray such that the medical device tray **102** can hold the body **704** of the medical device **702** without the body **704** of the medical device **702** rolling or moving undesirably. In some

examples, the medical device tray **102** can be U-shaped or have other shapes operable to hold the body **704** of the medical device **702**. Accordingly, the medical device tray **102** can maintain the position of the medical device **702** and provide precision, accuracy, and consistency when maneuvering the medical device **702**.

[0033] The medical device tray **102** can be slidably coupled to a device tray guide rail **104**. The device tray guide rail **104** can allow for motion of the medical device tray **102**. The medical device tray **102** can be operable to translate along the device tray guide rail **104**. In some examples, the device tray guide rail **104** can be operable to cause the medical device tray **102** to translate, for example, along a longitudinal axis. The device tray guide rail **104** can be configured to allow the medical device tray **102** to slide back and forth along a single axis defined by the device tray guide rail **104**. As the medical device tray **102** translates, the medical device **702** and/or the catheter **232** can be caused to translate as well. In some examples, as the catheter **232** translates, the medical device tray **102** translates to prevent pulling on the catheter **232** by the medical device **702**.

[0034] The catheter restoration system **100** can include a securing mechanism to secure the catheter **232**. For example, the catheter restoration system **100** can include at least one clamp **106**, **108** operable to secure the catheter **232**. The at least one clamp **106**, **108** can be operable to transition between an open configuration and a closed configuration. In the open configuration, the at least one clamp **106**, **108** can be operable to receive the catheter (e.g., catheter **232** as shown in FIGS. **2-3**). When in the closed configuration, the at least one clamp **106**, **108** can be operable to compress against the catheter **232** to immobilize the catheter **232** in relation to the at least one clamp **106**, **108**. The at least one clamp **106**, **108** can include any suitable type of clamping or securing mechanism operable to secure the catheter **232**.

[0035] The at least one clamp **106**, **108** can be operable to both secure the catheter **232** and move the catheter **232** throughout the catheter restoration system **100**. For example, the at least one clamp **106**, **108** can maneuver the catheter **232** through a reforming assembly **109**. In at least one example, the reforming assembly **109** can include a first wheel assembly **110**, a second wheel assembly **112**, and/or a reforming split mold **1213**. The reforming assembly **109** can be operable to reform the shape of the catheter **232** when the catheter **232** is translated along the longitudinal axis through the reforming assembly **109**. In some examples, the at least one clamp **106**, **108** can entirely control the motion of the catheter **232** once the catheter **232** is secured to the at least one clamp **106**, **108**. The at least one clamp **106**, **108** can provide motion back and forth through the reforming assembly **109**) by pushing and pulling the catheter **232** back and forth. The motion provided by the at least one clamp **106**, **108** to the catheter **232** can allow a softened material (e.g., material heated by the heat device **114**) of the catheter **232** to be moved back and forth through the reforming assembly **109**. By moving the catheter **232** back and forth through the reforming assembly **109**, any kinks or damage to the catheter **232** can be removed, thereby forming a uniform and consistent diameter of the catheter **232** and allowing the catheter **232** to be operable to be used in a patient safely.

[0036] In some examples, the at least one clamp **106**, **108** can include a first clamp assembly **106** and a second clamp assembly **108**. The first clamp assembly **106** and the second clamp assembly **108** can be operable to capture and hold a catheter **232** of the medical device **702** (for example as shown in FIGS. **2** and **3**). The first clamp assembly **106** can be operable to secure the catheter **232** at a first location and the second clamp assembly **108** can be operable to secure the catheter **232** at a second location. The heat device **114** can be between the first clamp assembly **106** and the second clamp assembly **108** such that the catheter **232** is secured at two locations on opposing sides of the heat device **114**. Similarly, the first clamp assembly **106** and the second clamp assembly **108** can secure the catheter **232** on opposite sides of the reforming assembly **109** such that the pulling the second clamp assembly **108** pulls the catheter **232** in a first direction through the reforming assembly **109** and pulling the first clamp assembly **106** pulls the catheter **232** in a second direction, opposite the first direction, through the reforming assembly **109**. Similarly, pushing the first clamp assembly **106** moves the catheter **232** in the second direction, while pushing the second clamp assembly **108** moves the catheter **232** in the first direction. The first clamp assembly **106** and the second clamp assembly **108** can provide motion to the catheter **232** back and forth along a longitudinal axis in relation to the reforming assembly **109**.

[0037] In some examples, the first clamp assembly **106** can be positioned proximal to the medical device tray **102**. The first clamp assembly **106** can be positioned between the medical device tray **102** and the heat device **114**. The second clamp assembly **108** can be positioned distal to the medical device tray **102**. The second clamp assembly **108** can be positioned on an opposite side of the heat device **114** than the first clamp assembly **106** (e.g., the heat device **114** is between the first clamp assembly **106** and the second clamp assembly **108**). The first clamp assembly **106** can be positioned between the second clamp assembly **108** and the medical device tray **102**. The first clamp assembly **106** and the second clamp assembly **108** can be any suitable type of clamping or securing mechanism operable to secure the catheter **232** of the medical device **702**.

[0038] The first clamp assembly **106** and/or the second clamp assembly **108** can be operable to transition between an open configuration and a closed configuration. In the open configuration, the first clamp assembly **106** and/or the second clamp assembly **108** can be operable to receive the catheter **232**. When in the closed configuration, the first clamp assembly **106** and/or the second clamp assembly **108** can be operable to compress against the catheter **232** to immobilize the catheter **232** in relation to the first clamp assembly **106** and/or the second clamp assembly **108**.

[0039] The catheter restoration system **100** can further include a reforming assembly **109**. The reforming assembly **109** can be operable to reform an exterior surface of the catheter **232**. In some examples, the reforming assembly **109** can be operable to reform the exterior surface of the catheter **232** to a consistent and uniform diameter such that the catheter **232** can have the same dimensions as an originally manufactured catheter, thereby allowing the catheter **232** to be used in a patient after a previous use. For example, the reforming assembly **109** can have a reforming component **201** operable to form the exterior surface of the catheter **232** into a uniform diameter. For example, the reforming component **201** can receive a kinked or damaged portion of the catheter **232** therein and provide a pressure or force to the catheter **232**, thereby smoothing any protrusions and moving the material from the protrusion to an indent in the exterior surface of the catheter **232** when the catheter is moved along a longitudinal axis through the reforming assembly **109**. In some examples, the reforming component **201** can be a hole, a series of holes, a groove, a channel or other geometries having a diameter equal to a desired diameter of the catheter **232**. In some examples, the kinked or damaged portion of the exterior surface of the catheter **232** is heated, thereby softening the exterior surface and allowing the exterior surface to be moldable, before the catheter **232** is reformed by the reforming assembly **109**. In some examples, the at least one clamp **106**, **108** is operable to translate or move the catheter **232** through the reforming assembly **109**. In some examples, the reforming assembly **109** is moveable along a length of the catheter **232**.

[0040] The reforming assembly **109** can be located between the first clamp assembly **106** and the second clamp assembly **108**. In some examples, the reforming assembly **109** can be located between the first clamp assembly **106** and the heat device **114**. In some examples, the reforming assembly **109** can be located between the heat device **114** and the second clamp assembly **108**. In some examples, multiple reforming assemblies **109** can be located between the first clamp assembly **106** and the second clamp assembly **108**. For example, a first reforming assembly **109** can be located between the first clamp assembly **106** and the heat device **114** and a second reforming assembly **109** can be located between the heat device **114** and the second clamp assembly **108**. In some examples, when the at least one clamp **106**, **108** is a single clamp, the reforming assembly **109** can be located between the at least one clamp **106**, **108** and the heat device **114**. In some examples, when the at least one clamp **106**, **108** is a single clamp, the heat device **114** can be between the reforming assembly **109** and the at least one clamp **106**, **108**.

[0041] In some examples, the reforming assembly **109** can include a first wheel assembly **110** and/or a second wheel assembly **112**. The first wheel assembly **110** can be operable to reform the catheter **232** by receiving the catheter **232** between grooves (reforming component **201**, for example, grooves **506**, **508**) in two rolling wheels **208**, **210**, thereby providing a pressure or force to the catheter **232** and forming a uniform diameter by smoothing any protrusions or indents in the catheter **232**. The second wheel assembly **112** can be operable to reform the catheter between grooves (for example grooves **506**, **508**) in two rolling wheels **214**, **216**, thereby providing a pressure or force to the catheter **232** and forming a uniform diameter by smoothing any protrusions or indents in the catheter **232**. In some examples, the reforming component **201** can be corresponding grooves (e.g., grooves **506**, **508**) in a circumference of each wheel **208**, **210** of the pair of rolling wheels **208**, **210**.

[0042] In at least one example, the first wheel assembly **110** can be located between the first clamp assembly **106** and the second clamp assembly **108**. In some examples, the first wheel assembly **110** can be located between the first clamp assembly **106** and the heat device **114**. The second wheel assembly **112** can be located between the first clamp assembly **106** and the second clamp assembly **108**. In some examples, the second wheel assembly **112** can be located between the heat device **114** and the second clamp assembly **108**. In some examples, the first wheel assembly **110** can be located between the first clamp assembly **106** and the second wheel assembly **112**. In some examples, the heat device **114** can be located between the first wheel assembly **110** and the second wheel assembly **112**. In some examples, the catheter restoration system **100** can have a single wheel assembly or three or more wheel assemblies. In some examples, the single wheel assembly (e.g., first wheel assembly **110** or second wheel assembly **112**) can be located between the heat device **114** and the first clamp assembly **106** or between the heat device **114** and the second clamp assembly **108**.

[0043] As illustrated in FIG. **2**, the first clamp assembly **106** can include a toggle component **200**, a handle **202**, a first clamping portion **206**, and a second clamping portion **204**. The toggle component **200** can be operable to transition between an unlocked position and a locked position. When the toggle component **200** is in the unlocked position, the first clamping portion **206** and/or the second clamping portion **204** can move relative to one another. When the toggle component **200** is in the locked position, the first clamping portion **206** and/or the second clamping portion **204** can be prevented from moving relative to one another. In at least one example, the toggle component **200** can include a clamp. In some examples, the toggle component **200** can include a button, an actuator, a motor, a braking system, etc. without deviating from the scope of the disclosure.

[0044] The first clamping portion **206** and the second clamping portion **204** can define a gap **236**. The gap **236** can be operable to receive a portion of a catheter **232**. In some examples, the first clamping portion **206** can be operable to move perpendicular to the longitudinal axis of the catheter **232** (e.g., axis defined by a length of the catheter **232**) when the toggle component **200** is in an unlocked position. In some examples, the first clamping portion **206** can include a moveable clamping portion. In some examples, the second clamping portion **204** can be static (e.g., remain in a fixed position). The first clamping portion **206** can be pushed towards the catheter **232** such that it exerts a securing force on the catheter **232** against the second clamping portion **204**. In some examples, the first clamping portion **206** and the second clamping portion **204** can both be moveable and can transition between open and closed configurations (e.g., increase and decrease the size of the gap **236**). The toggle component **200** can then be actuated to a locked position, thereby locking the moveable clamping portion **206** in place and securing the catheter **232** in the first clamp assembly **106**. In some examples, actuating the toggle component **200** to the locked position can automatically move the first clamping portion **206** and/or second clamping portion **204** towards the catheter **232**, and actuating the toggle component **200** to the unlocked position can automatically move the first clamping portion **206** and/or second clamping portion **204** away from the catheter **232**. It will be appreciated that other mechanisms can be used as alternatives to, or in conjunction with, the first clamp assembly **106** to secure the catheter **232** in relation to the medical device tray **102**.

[0045] As illustrated in FIG. **2**, the second clamp assembly **108** can include a toggle component **220**, a handle **202**, a first clamping portion **222**, and a second clamping portion **224**. The toggle component **220** can be operable to transition between an unlocked position and a locked position. When the toggle component **220** is in the unlocked position, the first clamping portion **222** and/or the second clamping portion **224** can move relative to one another. When the toggle component **220** is in the locked position, the first clamping portion **222** and/or the second clamping portion **224** can be prevented from moving relative to one another. In at least one example, the toggle component **220** can include a clamp. In some examples, the toggle component **220** can include a button, an actuator, a motor, a braking system, etc. without deviating from the scope of the disclosure.

[0046] The first clamping portion **222** and the second clamping portion **224** can define a gap **234**. The gap **234** can be operable to receive a portion of a catheter **232**. In some examples, the first clamping portion **222** can be operable to move perpendicular to the longitudinal axis of the catheter **232** (e.g., axis defined by a length of the catheter **232**) when the toggle component **220** is in an unlocked position. In some examples, the first clamping portion **222** can be a moveable clamping portion. In some examples, the second clamping portion **224** can be static (e.g., remain in a fixed position). The first clamping portion **222** can be pushed towards the catheter **232** such that it exerts a securing force on the catheter **232** against the second clamping portion **224**. In some examples, the first clamping portion **222** and the second clamping portion **224** can both be moveable and can transition between open and closed configurations (e.g., increase and decrease the size of the gap **234**). The toggle component **220** can then be actuated to a locked position, thereby locking the moveable clamping portion **222** in place and securing the catheter **232** in the second clamp assembly **108**. In some examples, actuating the toggle component **220** to the locked position can automatically move the first clamping portion **222** and/or second clamping portion **224** towards the catheter **232**, and actuating the toggle component **220** to the unlocked position can automatically move the first clamping portion **222** and/or second clamping portion **224** away from the catheter **232**. It will be appreciated that other mechanisms can be used as alternatives to, or in conjunction with, the second clamp assembly **108** to secure the catheter **232** in relation to the medical device tray **102**.

[0047] In some examples, the catheter **232** is secured to the first clamping assembly **106** and the second clamping assembly **108** such that the damaged or kinked portion of the catheter **232** is between the first clamp assembly **106** and the second clamp assembly **108**. In some examples, the first clamp assembly **106** and the second clamp assembly **108** provide tension to the catheter **232** between the first clamp assembly **106** and the second clamp assembly **108**. For example, the catheter **232** can be secured to the first clamp assembly **106** first and then pulled tight before securing the catheter **232** to the second clamp assembly **108** such that there is tension in the catheter **232** between the first clamp assembly **106** and the second clamp assembly **108**. In some examples, the catheter **232** can be secured to the second clamp assembly **108** first and then pulled tight before securing the catheter **232** to the first clamp assembly **106** such that there is tension in the catheter **232** between the first clamp assembly **106** and the second clamp assembly **108**. In some examples, the tension in the catheter **232** between the first clamp assembly **106** and the second clamp assembly **108** can ensure that the catheter **232** remains in line with an axis defined by the reforming component **201** of the reforming assembly **109** such that the material of the exterior surface of the catheter **232** is smooth after moving through the reforming assembly **109**.

[0048] In some examples, the at least one clamp **106**, **108** is moveable (e.g., slidable) along a guide rail (e.g., first clamp assembly guide rail **230** and/or second clamp assembly guide rail **228**). The at least one clamp **106**, **108** can be moveable back and forth along an axis defined by the guide rail (e.g., first clamp assembly guide rail **230** and/or second clamp assembly guide rail **228**). In some examples, the first clamp assembly **106** can be slidably coupled to a first clamp assembly guide rail **230**. For example, the first clamp assembly **106** can be operable to move, slide, and translate along the first clamp assembly guide rail **230**. The second clamp assembly **108** can be slidably coupled to a second clamp assembly guide rail **228**. For example, the second clamp assembly **108** can be operable to move, slide, and translate along the second clamp assembly guide rail **228**. In some examples, the first clamp assembly **106** and the second clamp assembly **108** can be slidably mounted to a single clamp guide rail (e.g., first clamp assembly guide rail **230** and/or second clamp assembly guide rail **228**). In some examples, the first clamp assembly **106** and the second clamp assembly **108** can be slidably mounted to the device tray guide rail **104**.

[0049] In some examples, the first clamp assembly **106** and the second clamp assembly **108** can be manually moved, slid, and/or translated along the first clamp assembly guide rail **230** and the second clamp assembly guide rail **228**, respectively, by an operator. Once the catheter **232** has been secured by the first clamp assembly **106** and the second clamp assembly **108**, the catheter **232** moves with the first clamp assembly **106** and the second clamp assembly **108** along the first clamp assembly guide rail **230** and the second clamp assembly guide rail **228**. Similarly, the body **704** of the medical device **702** (e.g., the portion of the medical device **702** held in the medical device tray **102**) can move with the medical device tray **102** along the device tray guide rail **104**. In this manner, the medical device **702** is moveable along an axis defined by the guide rails **104**, **228**, **230** within the catheter restoration system **100**. In some examples, handles **202**, **226** can allow an operator to slide the first clamp assembly **106** and the second clamp assembly **108** along the first clamp assembly guide rail **230** and the second clamp assembly guide rail **228**. In some examples, the first clamp assembly **106** and the second clamp assembly **108** can be caused to be moved, translated, or slid by a motor or an actuator in communication with a controller (for example controller **1300** as illustrated in FIG. **13**). In some examples, the at least one clamp **106**, **108** can be caused to move by other movement mechanisms (e.g., either automated or manual movement mechanisms).

[0050] While three separate guide rails are depicted (e.g., medical device guide rail **104**, first clamp assembly guide rail **230**, and second clamp assembly guide rail **228**), it will be appreciated that the catheter restoration system **100** can have a single guide rail configured to allow slidable mounting of the medical device tray **102**, first clamp assembly **106**, and second clamp assembly **108**. In some examples, the catheter restoration system **100** can include two guide rails-a device tray guide rail **104** and a guide rail for slidably coupling the first clamp assembly **106** and the second clamp assembly **108**. In some examples, when the at least once clamp **106**, **108** is a single clamp, the single clamp can be slidably coupled to a guide rail (e.g., device tray guide rail **104**, first clamp assembly guide rail **230**, or second clamp assembly guide rail **228**).

[0051] The catheter restoration system **100** can include at least one wheel assembly **110**, **112** (reforming assembly **109**) operable to provide a pressure or a surface to an exterior surface of the catheter **232**. The pressure or force can be operable to smooth out (e.g., form a uniform or consistent diameter by removing protrusions and filling indents) a damaged or kinked portion of the catheter **232**. As illustrated in FIG. **2**, the catheter restoration system **100** can include a first wheel assembly **110** and a second wheel assembly **112**. The first wheel assembly **110** can include a pair of rolling wheels (e.g., a lower wheel **208** and an upper wheel **210**). The rolling wheels (e.g., lower wheel **208** and upper wheel **210**) can be operable help guide the motion of the catheter **232** through the wheels (e.g., lower wheel **208** and upper wheel **210**). For example, as the rolling wheels (e.g., lower wheel **208** and upper wheel **210**) receive the catheter **232**, the rolling wheels (e.g., lower wheel **208** and upper wheel **210**) can rotate in a direction corresponding to the motion of the catheter **232**, thereby allowing ease of motion by the catheter **232** between the rolling wheels (e.g., lower wheel **208** and upper wheel **210**). The rolling wheels (e.g., lower wheel **208** and upper wheel **210**) can ensure that the catheter **232** remains in the grooves (**406**, **506**, **508**) by guiding the motion of the catheter **232** (e.g., the rotation of the wheels **208**, **210** guides the catheter **232** to remain within the grooves **406**, **506**, **508**).

[0052] The first wheel assembly **110** can be located between the first clamp assembly **106** and the second clamp assembly **108**. In some examples, the first wheel assembly **110** can be located between the first clamp assembly **106** and the heat device **114**. In some examples, the lower wheel **208** can be fixed in position such that the lower wheel **208** cannot translate in any direction but can rotate. The upper wheel **210** can be coupled to a rod **512** within a housing **518** (as shown in FIG. **5**). The housing **518** can be moveable along a first wheel assembly guide rail **212**, thereby allowing the vertical position of the upper wheel **210** to be adjustable. For example, the upper wheel **210** can be in a raised position (e.g., not contacting the lower wheel **208**) while the catheter **232** is being secured in the at least one clamp (e.g., first clamp assembly **106** and the second clamp assembly **108**). Once the catheter **232** is secured, the upper wheel **210** can be lowered such that the upper wheel **210** contacts the catheter **232** by moving the housing **518** and rod **510** connected to the upper wheel **210** downward along the first wheel assembly guide rail **212**.

[0053] The second wheel assembly **112** can have a pair of rolling wheels (e.g., lower wheel **214** and upper wheel **216**). The second wheel assembly **112** can be located between the first clamp assembly **106** and the second clamp assembly **108**. In some examples, the second wheel assembly **112** can be located between the heat device **114** and the second clamp assembly **108**. In some examples, the lower wheel **214** can be fixed in position such that the lower wheel **214** cannot translate in any direction and can only rotate. The upper wheel **216** can be rotatably coupled to a rod **510** within a housing **518** (as shown, for example, in FIG. **5**). The housing **518** can be moveable along a second wheel assembly guide rail **218**, thereby allowing the vertical position of the upper wheel **216** to be adjustable. For example, the upper wheel **216** can be in a raised position while the catheter **232** is being secured in the at least one clamp (e.g., first clamp assembly **106** and the second clamp assembly **108**). Once the catheter **232** is secured, the upper wheel **216** can be lowered toward the lower wheel **214** such that the upper wheel **216** contacts the catheter **232** by moving the housing **518** and rod **510** connected to the upper wheel **216** downward along the second wheel assembly guide rail **218**.

[0054] In some examples, the upper wheels **210**, **216** can be manually locked at a vertical position along the first wheel assembly guide rail **212** and the second wheel assembly guide rail **218** using a toggle component or other locking mechanisms suitable to secure the upper wheels **210**, **216** at a desired vertical position within the catheter restoration system **100** without deviating from the present disclosure. In other examples, the height of the upper wheels **210**, **216** can be adjusted by a controller **1300** using a motor or actuator, as described further herein.

[0055] FIG. **2** illustrates the catheter restoration system **100** in a loading position. The loading position allows the catheter **232** to be secured in the at least one clamp (e.g., first clamp assembly **106** and second clamp assembly **108**). After the catheter **232** has been secured to the at least one clamp **106**, **108**, the upper wheels **210**, **216** can be lowered such that the upper wheels **210**, **216** contact the respective lower wheels **208**, **214**. When the upper wheels **210**, **216** contact the respective lower wheels **208**, **214**, the catheter restoration system **100** can be in a reforming position, as illustrated in FIG. **3**. In the reforming position, the heat device **114** can provide heat to the catheter **232** and then the catheter **232** can be translated back and forth through the reforming assembly **109** thereby providing a pressure or force to the catheter **232** and forming a uniform diameter on the exterior surface of the catheter **232**.

[0056] As illustrated in FIG. **3**, the heat device **114** can be located between the first wheel assembly **110** and the second wheel assembly **112**. The heat device **114** can have a thermal element **300** and a nozzle **302**. The heat device **114** can also include a housing **304** having one or more vents **306**. The one or more vents **306** can be operable to dissipate heat generated by the thermal element **300** out of the housing **304**. The thermal element **300** can heat air or other gasses to a temperature and the nozzle **302** can be operable to provide the heated air to the catheter **232**.

[0057] In some examples, the thermal element **300** can be configured to heat the air or other gasses to a temperature sufficient to soften the exterior surface of the catheter **232**. In some examples, the temperature of the heated air and/or the duration the heated air provided is sufficient to soften the exterior surface of the catheter **232** without melting the catheter **232**. The nozzle **302** can provide the heated air to a damaged surface of the catheter **232**. For example, the catheter **232** may have a kink or other surface damage such that it needs to be reformed in order to meet certain tolerances for reuse in a patient. The kinked or damaged portion of the catheter **232** can be aligned with the nozzle **302** such that the heated air or gas is provided directly to the kinked or damaged portion. For example, the catheter **232** can be secured by the first clamp assembly **106** and the second clamp assembly **108** such that the kinked or damaged portion aligns with the nozzle **302**. Once the kinked or damaged portion of the catheter **232** is softened, the catheter **232** can be reformed by the reforming assemblies (e.g., first wheel assembly **110** and/or second wheel assembly **112** and/or reforming split mold **1213**) described herein.

[0058] The thermal element **300** can be operable to heat air or other gasses to a temperature of about 50 degrees Celsius (C) to about 55 degrees C., about 55 degrees C. to about 60 degrees C., about 60 degrees C. to about 65 degrees C., about 65 degrees C. to about 70 degrees C., about 70 degrees C. to about 75 degrees C., about 75 degrees C. to about 80 degrees C., about 80 degrees C. to about 85 degrees C., about 85 degrees C. to about 90 degrees C., about 90 degrees C. to about 95 degrees C., about 95 degrees C. to about 100 degrees C., about 100 degrees C. to about 105 degrees C., about 105 degrees C. to about 110 degrees C., about 110 degrees C. to about 115 degrees C., about 115 degrees C. to about 120 degrees C., about 120 degrees C. to about 125 degrees C., about 125 degrees C. to about 130 degrees C., about 130 degrees C. to about 135 degrees C., about 135 degrees C. to about 140 degrees C., about 140 degrees C. to about 145 degrees C., about 145 degrees C. to about 150 degrees C., about 150 degrees C. to about 155 degrees C., about 155 degrees C. to about 160 degrees C., about 160 degrees C. to about 165 degrees C., about 165 degrees C. to about 170 degrees C., or any range therebetween.

[0059] FIG. **4** illustrates an example of a wheel **400** (e.g., upper wheels **210**, **216** and lower wheels **208**, **214**). The wheel **400** can include a marking **402**, a hole **404**, and a groove **406**. The marking **402** can be indicative of the type of wheel. For example, the marking **402** can indicate the size of the groove **406**. The groove **406** can extend along a circumference of the wheel **400**. The groove **406** can be formed along the perimeter of the wheel **400**. For example, the groove **406** can be formed in the lateral, external side of the perimeter of the wheel **400**. The groove **406** can be operable to receive a portion of a diameter of the catheter **232** and a corresponding groove in another wheel can be operable to receive the remaining portion of the diameter of the catheter **232**, for example as illustrated in FIG. **5**. When the catheter **232** is received in the groove **406** and corresponding groove (e.g., grooves **506**, **508** in FIG. **5**), the grooves **506**, **508** can provide a pressure or force to the catheter **232**, thereby smoothing out the exterior surface of the catheter **232**, removing any protrusions and filling any indents, and forming a uniform and consistent diameter on the exterior surface of the catheter **232**. Different types of catheters can have different diameters. These different diameters can require different sized grooves in order to properly reform the catheter **232**. For example, the grooves **406**, **506**, **508** can be operable to entirely enclose a diameter of the catheter **232** in order to reform the catheter **232**, therefore, different sized catheters require different sized grooves **406**, **506**, **508**. The marking **402** can be indicative of a wheel **400** to be used with catheters **232** having a certain diameter. The hole **404** can be operable to receive a rod **510** of the wheel assembly (e.g., first wheel assembly **110** and/or second wheel assembly **112**), thereby allowing the wheels **400** to be interchangeable within the catheter restoration system **100**. In this manner, different wheels **400** with different groove sizes can be selected for use in the catheter restoration system **100** depending on the type of catheter **232** to be reformed.

[0060] FIG. **5** illustrates an example of a wheel assembly **500** (e.g., first wheel assembly **110** and second wheel assembly **112**). The wheel assembly **500** can be operable to reform the exterior surface of the catheter **232** to a uniform and consistent diameter. For example, the wheel assembly **110**, **112**, **500** can receive the catheter **232** between an upper wheel **210**, **216**, **502** and lower wheel **208**, **214**, **504** and provide a pressure or force to the catheter **232**, thereby removing any protrusions

and filling any indents in the catheter **232**. The wheel assembly **500** can include an upper wheel housing **518**, an upper wheel rod **512**, an upper wheel rod head **514**, an upper wheel **502**, a lower wheel housing **520**, a lower wheel rod **510**, a lower wheel rod head **516**, and a lower wheel **504**.
[0061] The upper wheel **502** can be placed within the upper wheel housing **518** and the upper wheel rod **512** can be inserted through a hole in a proximal end of the upper wheel housing **518**, a hole in the upper wheel **502**, and a hole at the distal end of the upper wheel housing **518**. The upper wheel rod head **514** can be pushed up against a surface of the upper wheel housing **518**, thereby locking the upper wheel **502** in place within the upper wheel housing **518**. The upper wheel **502** can rotate about the upper wheel rod **512**. Similarly, the lower wheel **504** can be placed within the lower wheel housing **520** and the lower wheel rod **510** can be inserted through a hole in a proximal end of the lower wheel housing **520**, a hole in the lower wheel **504**, and a hole at the distal end of the lower wheel housing **520**. The lower wheel rod head **516** can be pushed up against a surface of the lower wheel housing **520**, thereby locking the lower wheel **504** in place within the lower wheel housing **520**. The lower wheel **504** can rotate about the lower wheel rod **510**.
[0062] In some examples, the upper wheel rod **512** and the lower wheel rod **510** can have threads on a side of the wheel rods **510**, **512** opposite the wheel rod heads **514**, **516**. The upper wheel rod head **514** and the lower wheel rod head **516** can have slots for inserting a tool (e.g., screwdriver, Allen wrench, etc.). The upper wheel rod head **514** and the lower wheel rod head **516** can be rotated by the tool, thereby rotating the threads of the upper wheel rod **512** and the lower wheel rod **510** into corresponding threads in the holes on the distal side of the upper wheel housing **518** and the lower wheel housing **520** (e.g., side opposite of the insertion side of the wheel rods **510**, **512**). By rotating the threads of the upper wheel rod **512** and lower wheel rod **510** into the corresponding threads of the upper wheel housing **518** and lower wheel housing **520**, the upper wheel **502** and the lower wheel **504** are secured in the upper wheel housing **518** and the lower wheel housing **520**. In some examples, the rods **510**, **512** can have a snap fit mechanism to couple to the housings **518**, **520**. In some examples, the rods **510**, **512** can have other mechanisms to couple to the housings **518**, **520**.
[0063] The upper wheel **502** can form a groove **506** and the lower wheel **504** can form a groove **508**. As described herein, different wheels with different groove sizes can be used in the catheter restoration system **100** depending on the diameter of the catheter **232** to be restored. The groove **506** of the upper wheel **502** and the groove **508** of the lower wheel **504** are positioned such that the catheter **232** can be received within the grooves **506**, **508**. The grooves **506**, **508** can then maintain the position of the catheter **232** while the catheter **232** is being translated back and forth through the upper wheel **502** and lower wheel **504**. Both the groove **506** of the upper wheel **502** and the groove **508** of the lower wheel **504** are configured to contact the surface of the catheter **232** to reform the catheter **232**. The grooves **506**, **508** of the upper wheel **502** and lower wheel **504** can have substantially the same size and/or shape when used in the catheter restoration system **100**. In other words, the upper wheel **502** and the lower wheel **504** can have the same groove size for a given catheter. In some examples, the upper wheel housing **518** and the lower wheel housing **520** are u-shaped wheel housings. Other wheel housing shapes can be used.
[0064] When the catheter **232** is heated by the heat device **114** and the exterior surface of the catheter **232** is softened, the catheter **232** can move or be translated along the at least one guide rail (e.g., device tray guide rail **104**, first clamp assembly guide rail **230**, and/or second clamp assembly guide rail **228**). The catheter **232** can be reformed by contact of the catheter **232** with the grooves **506**, **508** in the upper wheel **502** and lower wheel **504**, thereby removing any kinks or damage to the exterior surface of the catheter **232**. In some examples, the grooves **506**, **508** are configured to enclose the diameter of the catheter **232**. When the catheter **232** is translated through the grooves **506**, **508**, the grooves **506**, **508** can smooth out any protrusions and move the extra material from the protrusions to corresponding indents, thereby forming a uniform and consistent diameter of the catheter **232**. When the catheter **232** has a consistent and uniform diameter, the catheter **232** can

have the same diameter as an originally manufactured catheter and be safe for clinical use in a patient. In some examples, when the catheter **232** is heated by the heat device **114** and the exterior surface of the catheter **232** is softened, the catheter **232** can be moved (e.g., by an operator) along the at least one guide rail (e.g., device tray guide rail **104**, first clamp assembly guide rail **230**, and/or second clamp assembly guide rail **228**), thereby moving the catheter **232** back and forth through the grooves **506**, **508**. In some examples, when the catheter **232** is heated by the heat device **114** and the exterior surface of the catheter **232** is softened, the catheter **232** can be moved by a motor and/or actuator controlled by controller **1300** along the at least one guide rail (e.g., device tray guide rail **104**, first clamp assembly guide rail **230**, and/or second clamp assembly guide rail **228**) thereby moving the catheter **232** back and forth through the grooves **506**, **508**.

[0065] FIG. **6** illustrates the second clamp assembly **108**. The second clamp assembly **108** can include a first end stop **600** and a second end stop **602**. The first end stop **600** and the second end stop **602** can be operable to limit the distance the second clamp assembly **108**, and thereby the first clamp assembly **106** and medical device tray **102**, can move along the at least one guide rail (e.g., device tray guide rail **104**, first clamp assembly guide rail **230**, and/or second clamp assembly guide rail **228**). In this manner, the first end stop **600** and the second end stop **602** can prevent movement of the second clamp assembly **108** beyond the end stops. Limiting the distance of movement can improve the efficiency of the catheter restoration system **100** by ensuring that the kinked or damaged portion of the catheter **232** is reformed by the wheel assembly **110**, **112**, **500** or wheel assemblies **110**, **112**, **500** without wasting additional time rolling unkinked or undamaged portions of the catheter through the wheel assembly **110**, **112**, **500** or wheel assemblies **110**, **112**, **500**. While the first end stop **600** and second end stop **602** are shown for the second clamp assembly **108**, it will be appreciated that the end stops could prevent movement of the first clamp assembly **106** or the medical device tray **102**, since the first clamp assembly **106**, second clamp assembly **108**, and medical device tray **102** all move together when a catheter **232** is secured to the catheter restoration system **100**.

[0066] In some examples, the second clamp assembly **108** can include a marker **604**. The marker **604** can provide a measure for a distance to move the second clamp assembly **108**, and thereby the first clamp assembly **106** and the medical device tray **102**, along the guide rails (e.g., device tray guide rail **104**, first clamp assembly guide rail **230**, and/or second clamp assembly guide rail **228**) to ensure sufficient contact of the kinked or damaged portion of the catheter **232** with the wheels **208**, **210**, **214**, **216** of the wheel assemblies **110**, **112**. For example, the marker **604** can indicate to an operator to move the second clamp assembly **108** to the left of the marker **604**, before moving the second clamp assembly **108** back to the second end stop **602**.

[0067] FIG. **7** illustrates another example of a catheter restoration system **100**. In the example as illustrated in FIG. **7**, the catheter reformation system **100** can have a single reforming assembly **109** (e.g., first wheel assembly **110**). The upper wheel **210** of the first wheel assembly **110** can have an adjustable vertical position within the catheter restoration system **100**. The upper wheel toggle component **700** can lock the upper wheel **210** at a set vertical position. For example, when the catheter **232** is being loaded into the catheter restoration system **100**, the upper wheel **210** can be locked at a maximum height (e.g., for ease of clamping the catheter **232** to the at least one clamp **106**, **108**). When the catheter **232** is loaded into the catheter restoration system **100** and the reformation process is ready to begin, the upper wheel toggle component **700** can be unlocked, the upper wheel **210** can be lowered such that the groove **506** of the upper wheel **210** contacts the surface of the catheter **232**, and the upper wheel toggle component **700** can be locked, such that the grooves **506**, **508** in the upper wheel **210** and lower wheel **208** are in contact with the catheter **232**. In some examples, the toggle component **700** can be a manually actuated component (e.g., button, clamp, etc.) or an automated component (e.g., in communication with the controller **1300** and actuated by a motor, actuator, etc.)

[0068] FIG. **7** further illustrates the medical device **702** loaded in the catheter restoration system

100. The medical device **702** can include a body **704** which is held in the medical device tray **102** and a catheter **232** which is secured by the first clamp assembly **106** and the second clamp assembly **108**. The kinked or damaged portion of the catheter **232** can be aligned with the nozzle **302** of the heat device **114**. In this manner, the kinked or damaged portion of the catheter **232** can be provided heat first, and then once the kinked or damaged is softened, the kinked or damaged portion can be reformed by the grooves **506**, **508** in the wheels **208**, **210**, **214**, **216**, **502**, **504** in the wheel assembly **110**, **112**, **500**. The grooves **506**, **508** can enclose an entire diameter of the catheter **232** such that when the catheter is moved back and forth through the grooves **506**, **508**, the grooves **506**, **508** move any excess material (e.g., material that extends outside of the desired diameter) to areas of the catheter **232** that have less material than desired (e.g., areas with indents that have insufficient amounts of material). In this manner, the catheter **232** can be smoothed out such that the catheter **232** has a uniform and consistent diameter.

[0069] FIG. **8** illustrates a body support **800** that can be operable to support the body **704** (e.g., handle) of the medical device **702**. The body support **800** is configured to support the body **704** of the medical device **702** when the kink or damaged portion of the catheter **232** is close to the body **704**. The body support **800** allows the catheter **232** near the body **704** to be closer to the plane of the first clamp assembly **106**. In this manner, kinks and damaged portions near the body **704** can be reformed by the catheter restoration system **100**.

[0070] FIG. **9** illustrates a catheter restoration system **100** loaded with a medical device **702**. As illustrated in FIG. **9**, the medical device **702** can be loaded in a reverse tray **900** opposite the medical device tray **102** (e.g., on the opposite side of the heat device **114**). The reverse tray **900** can be located near the second clamp assembly **108** and on a side of the second clamp assembly **108** opposite the heat device **114**. Accordingly, the reverse tray **900** is operable to receive the medical device **702** while the medical device tray **102** is operable to receive the catheter **232**. The reverse tray **900** can provide another option for loading the medical device **702** to ensure the kinked or damaged portion of the catheter **232** is reformed. In some examples, the reverse tray **900** allows the catheter **232** to be installed in the catheter restoration system **100** along the same plane as the medical device **702**, thereby preventing the catheter **232** from being bent in relation to the medical device **702**.

[0071] In some examples, the catheter restoration system **100** can further include one or more fans **906**, as illustrated in FIG. **9**. The one or more fans **906** can be operable to provide cool air to the catheter **232** thereby shortening the cooling time of the catheter **232** after the catheter **232** has been reformed.

[0072] The catheter restoration system **100** can further include a display screen **902** and buttons **904**. The display screen **902** can be in communication with a processor **1320** and/or controller **1300**. The display screen **902** can be operable to display various instructions, statuses, and warnings regarding the operation of the catheter restoration system **100**. For example, the display screen **902** can display instructions to choose a recipe (e.g., parameters such as temperature, heating duration, cooling duration, rolling duration, etc. for a type of catheter), secure the catheter **232** (e.g., connect device), ensure correct device positioning, begin heat device warmup, begin heating, begin rolling, cooling in progress, remove medical device, and confirm medical device restoration. The display screen **902** can further display a status of the catheter restoration system **100**. For example, the display screen **902** can display a preheating status, a providing heat status, a ready for rolling status, a cooling status, or other statuses related to the operation of the catheter restoration system **100**.

[0073] FIGS. **10**A-**10**F illustrate examples of various instructions, statuses, and warnings that can be displayed on the display screen **902**. As illustrated in FIG. **10**A, the display screen **902** can display a choose recipe screen. The choose recipe screen can provide different recipes for different types of catheters. In some examples, the recipe can include the various parameters for a catheter **232** such as the wheel groove size to use, the temperature, the heated air duration, the roll time, the cooling time, and other parameters. As illustrated in FIG. **10**B, the display screen **902** can display a run again screen, thereby allowing the operator to run the same recipe for another catheter of the same type or to rerun the system for the same catheter **232**. As illustrated in FIG. **10**C, the display screen **902** can display an instruction to have the operator ensure that the medical device **702** is properly positioned. As illustrated in FIG. **10**D, the display screen **902** can display a warning that the heated air or gas from the heat device **114** is about to be provided to the catheter **232**. In some examples, the warning can further include a countdown timer, thereby allowing the operator to know exactly when the heated air or gas will be applied to the catheter **232**.

[0074] As illustrated in FIG. **10**E, the display screen **902** can display a warning that heated air or gas is being provided to the catheter **232**. In some examples, the warning can further include a countdown timer, thereby allowing the operator to know exactly when the heated air or gas will stop being provided to the catheter **232**. As illustrated in FIG. **10**F, the display screen **902** can display an instruction to begin rolling the softened material on the catheter **232**. The begin rolling screen can be displayed after the catheter **232** has been heated such that the kinked or damaged portion of the catheter **232** has been softened. The begin rolling screen can further include a countdown timer, thereby informing the operator of how long to roll the catheter **232** (e.g., translate the catheter **232** back and forth along the at least one guide rail **104**, **228**, **230** between the wheel assembly **110**, **112**, **500** or wheel assemblies **110**, **112**, **500**, thereby contacting the kinked or damaged portion of the catheter **232** with the grooves **506**, **508** in the wheels **208**, **210**, **214**, **216**, **502**, **504**).

[0075] It will be appreciated that the display screen **902** can be operable to display any instructions, warnings, or statuses of the catheter restoration system **100**. For example, the display screen **902** can display any instruction, warning, or status of the method described herein.

[0076] The buttons **904** can allow an operator to set and control various parameters of the catheter restoration system **100**. For example, the buttons **904** can allow an operator to select parameters such as a temperature of heated air or gas provided by the heat device **114**, a duration for the heated air or gas to be provided to the catheter **232**, a fan speed, and a cooling duration. The buttons **904** can further allow the operator to electronically actuate the clamp assemblies **106**, **108** and the wheel assemblies **110**, **112** and translate the medical device **702** on the guide rails **104**, **228**, **230** when the clamp assemblies **106**, **108** and wheel assemblies **110**, **112** are electronically controllable (e.g., via motors and a processor **1320** and/or controller **1300** in communication with the motors).

[0077] In other examples, the display screen **902** can be a touch screen operable to receive inputs from an operator. In another example, the catheter restoration system **100** can have a controller **1300** and processor **1320** operable to be in wireless or wired communication with a computing device (e.g., mobile phone, computer, etc.). The computing device can control the operational parameters (e.g., temperature, duration of heating, clamp actuation, wheel height, motion of the medical device, etc.) of the catheter restoration system **100**. In this manner, an operator can control the catheter restoration system **100** without having to manually actuate the various components. For example, motors can be used to drive the clamp assemblies **106**, **108** along the guide rails **104**, **228**, **230**, actuate clamp assemblies **106**, **108** to secure the catheter **232**, adjust the height of the upper wheel **210**, **216** of the wheel assemblies **110**, **112**, and other various automated functions. Further, the processor **1320** and/or controller **1300** can be operable to cause the heat device **114** to warm up and provide heated air or gas to the catheter **232**.

[0078] The catheter restoration system **100** can be connected to a power supply to power the heat device **114**, the display screen **902**, and any motors for actuating the various components of the catheter restoration system **100** as described herein.

[0079] FIG. **11** illustrates the catheter restoration system **100**. The catheter restoration system **100** can further include a fume fan **1100**. For example, the fume fan **1100** can be configured to pull any fumes given off by the catheter **232** as it is provided the heated air or gas from the heat device **114**. For example, once the heat device **114** begins providing heated air or gas to the catheter **232**, the fume fan **1100** can be turned on and begin pulling any fumes given off by the catheter **232**. The catheter restoration system **100** can further include a filter (e.g., fume scrubber) (not shown) operable to filter out the fumes. In some examples, the filter can be located within a housing that houses the fume fan **1100**. The filter can be contained in the housing in the path of air pulled in by the fume fan **1110**. The filter can be located behind the fume fan **1100**, such that the fumes are pulled in by the fume fan **1100** and then filtered.

[0080] The fume fan **1100** can also act as a cooling fan after the softened material of the catheter **232** has been rolled. For example, after the catheter **232** has been rolled through the wheel assembly **110**, **112**, the fume fan **1100** can be configured to blow cool air towards the catheter **232** (i.e., the fume fan **1100** can operate in both a pulling air mode and a pushing air mode), thereby cooling the catheter **232**. In some examples, the cooling fan can be its own component (e.g., the catheter restoration system **100** includes both a cooling fan **906** and a fume fan **1100**).

[0081] The catheter restoration system **100** can be configured to reprocess any catheters that have kinks or damaged exterior surfaces. Non-limiting examples of catheters to be restored by the catheter restoration system include AcuNav, ViewFlex, and SoundStar catheters. The wheel groove size can be chosen based on the type of catheter. For example, the groove size of the wheels **208**, **210**, **214**, **216**, **502**, **504** can be configured to contact catheters having French sizes of 8, 9, 10 or other French sizes (e.g., diameters). Accordingly, the catheter restoration system **100** can accommodate and reprocess a variety of catheters, for example conventional catheters, imaging catheters, diagnostic catheters, treatment catheters, etc.

[0082] It will be appreciated that other configurations of the catheter restoration system **100** can be used. For example, as an alternative to, or in conjunction with, the slidable clamp assemblies **106**, **108**, the wheel assemblies **110**, **112**, **500** can be slidable along a length of the catheter **232**. Further, the bottom wheel **208**, **214** can have adjustable height while the upper wheel **210**, **216** can have a fixed height.

[0083] FIGS. **12**A-**12**C illustrates a split mold reforming assembly **1200**. The split mold reforming assembly **1200** can have a heat split mold **1205** operable contain the kinked or damaged portion of the catheter **232** while heat is being applied to the kinked or damaged portion catheter **232** by the heat device **114**. The split mold reforming assembly **1200** can include a reforming split mold **1213** (reforming assembly **109**). The reforming split mold **1213** can be operable to enclose a diameter of the catheter **232** and reform the diameter of the catheter **232** to a desired diameter by translating the catheter **232** back and forth through the reforming component **201**. In some examples, the reforming component **201** can be a hole formed by the connected reforming split mold **1213** (e.g., two half-circle holes **1209**, **1211** forming a hole when the mold halves are connected). The hole (e.g., two half-circle holes **1209**, **1211**) can move excess material (e.g., protrusions) to areas of the catheter lacking material (e.g., indents), thereby smoothing out the diameter of the catheter **232** and reforming the catheter **232** to the catheter's **232** original diameter.

[0084] In some examples, the split mold reforming assembly **1200** can be used in conjunction with, or as an alternative to, the wheel assemblies **110**, **112**, **500** described herein. The split-mold reforming assembly **1200** can include a heat split mold **1205**. The heat split mold **1205** can include a first heat mold half **1202** and a second heat mold half **1204**. The kinked or damaged portion of the catheter **232** can be loaded into the heat split mold **1205**. The first heat mold half **1202** and the second heat mold half **1204** can each form a half-circle hole **1201**, **1203** to receive the damaged or kinked portion of the catheter **232**, as illustrated in FIG. **12**A. The first heat mold half **1202** and the second heat mold half **1204** can then be enclosed around the kinked or damaged portion of the catheter **232** (e.g., the kinked or damaged portion of the catheter **232** fits within the hole created by the two half-circle holes **1201**, **1203**). The first heat mold half **1202** and the second heat mold half **1204** can be operable to secure to one another via a locking mechanism (e.g., snap-fit mechanism, magnetic mechanism, etc.). Heated air or gas can then be applied to the kinked or damaged portion of the catheter **232** via the nozzle **302** of the heat device **114**, as illustrated for example in FIGS.

12A-**12**B.

[0085] Once the catheter **232** has been heated such that the material is softened, the catheter **232** can be reformed by a reforming split mold **1213**, as illustrated in FIG. **12**C. The reforming split mold **1213** can include a first reforming half **1210** and a second reforming half **1208**. The reforming split mold **1213** can have a reforming component **201**. The first reforming half **1210** and the second reforming half **1208** can each have a half-circle hole **1209**, **1211** which can combine to form a circle hole (reforming component **201**). The half-circle holes **1209**, **1211** can combine to form a circle hole (reforming component **201**) having a diameter equal to the desired diameter of the catheter **232**. When the first reforming half **1210** and the second reforming half **1208** are connected around the softened material, the catheter **232** can be translated back and forth through the circle hole (e.g., formed by the half-circle holes **1209**, **1211**), thereby reforming the kinked or damaged portion of the catheter **232** by removing protrusions and filling indents of the catheter **232**. The catheter **232** then molds and reforms to the shape of the circle hole (e.g., formed by the two half-circle holes **1209**, **1211**) to fix the kinked and/or damaged portion of the catheter **232**. The first reforming half **1210** and the second reforming half **1208** can each be connected to a guide rail **1212**, **1206**. The guide rails **1212**, **1206** can be configured to allow movement of the first reforming half **1210** and second reforming half **1208** from an unconnected position to a connected position. The first reforming half **1210** and the second reforming half **1208** can also lock to one another via a locking mechanism (e.g., snap fit mechanism, magnetic mechanism, etc.).

[0086] In some examples, a support structure (not shown) or support pressure can be applied to an interior lumen of the catheter **232**. In some examples, the support structure can be a rod or a guidewire sized such that the interior lumen is completely contacted by the rod or the guidewire. In other examples, a compressor can provide a pressure to the interior lumen. The support structure or support pressure can ensure that the catheter **232** does not collapse. Further, the support structure or support pressure can ensure that the softened material is fully smoothed out by allowing any indents in the catheter **232** to be filled, thereby allowing the catheter **232** to have a uniform and consistent diameter after reforming.

[0087] FIG. **13** is a block diagram of an exemplary controller **1300**. Controller **1300** is configured to perform processing of data and communicate with the sensors **1360**, motors for actuating components (e.g., clamp assemblies **106**, **108**, wheel assemblies **110**, **112**, etc.), and the heat device **114**. In operation, controller **1300** communicates with one or more of the above-discussed components and may also be configured to communication with remote devices/systems.

[0088] As shown, controller **1300** includes hardware and software components such as network interfaces **1310**, at least one processor **1320**, sensors **1360** (e.g., sensors for determining position of components, power delivered to motors, etc.) and a memory **1340** interconnected by a system bus **1350**. Network interface(s) **1310** can include mechanical, electrical, and signaling circuitry for communicating data over communication links, which may include wired or wireless communication links.

[0089] Network interfaces **1310** are configured to transmit and/or receive data using a variety of different communication protocols.

[0090] Processor **1320** represents a digital signal processor (e.g., a microprocessor, a microcontroller, or a fixed-logic processor, etc.) configured to execute instructions or logic to perform tasks for operation of the catheter restoration system **100**. Processor **1320** may include a general purpose processor, special-purpose processor (where software instructions are incorporated into the processor), a state machine, application specific integrated circuit (ASIC), a programmable gate array (PGA), an individual component, a distributed group of processors, and the like. Processor **1320** typically operates in conjunction with shared or dedicated hardware, including but not limited to, hardware capable of executing software and hardware. For example, processor **1320** may include elements or logic adapted to execute software programs and manipulate data structures **1345**, which may reside in memory **1340**.

[0091] Sensors **1360**, which may include sensors for positioning and operation of various components disclosed herein, typically operate in conjunction with processor **1320** to perform measurements, and can include special-purpose processors, detectors, transmitters, receivers, and the like. In this fashion, sensors **1360** may include hardware/software for generating, transmitting, receiving, detection, logging, and/or sampling various parameters of the catheter restoration system **100**.

[0092] Memory **1340** comprises a plurality of storage locations that are addressable by processor **1320** for storing software programs and data structures **1345** associated with the embodiments described herein. An operating system **1342**, portions of which may be typically resident in memory **1340** and executed by processor **1320**, functionally organizes the device by, inter alia, invoking operations in support of software processes and/or services **1344** executing on controller **1300**. These software processes and/or services **1344** may perform processing of data and communication with controller **1300**, as described herein. Note that while process/service **1344** is shown in centralized memory **1340**, some examples provide for these processes/services to be operated in a distributed computing network.

[0093] It will be apparent to those skilled in the art that other processor and memory types, including various computer-readable media, may be used to store and execute program instructions pertaining to functions of the catheter restoration system **100** described herein. Also, while the description illustrates various processes, it is expressly contemplated that various processes may be embodied as modules having portions of the process/service **1344** encoded thereon. In this fashion, the program modules may be encoded in one or more tangible computer readable storage media for execution, such as with fixed logic or programmable logic (e.g., software/computer instructions executed by a processor, and any processor may be a programmable processor, programmable digital logic such as field programmable gate arrays or an ASIC that comprises fixed digital logic. In general, any process logic may be embodied in processor **1320** or computer readable medium encoded with instructions for execution by processor **1320** that, when executed by the processor **1320**, are operable to cause the processor **1320** to perform the functions described herein.

[0094] Further provided herein are methods for reforming and/or restoring a catheter of a medical device. The methods can be performed using the systems described herein. FIG. **14** illustrates a flow chart of a method **1400** for removing a kink from a catheter of a medical device and/or reforming a catheter of a medical device. In some examples, the method can begin by cleaning the catheter restoration system and all of the components described herein.

[0095] The method **1400** can then include determining the type of catheter (e.g., French size (diameter) of the catheter) to be reformed. Based on the type of catheter, wheels can be selected and secured to the catheter restoration system with a groove size corresponding to the diameter of the catheter to be reformed. Securing the wheels to a wheel assembly of the catheter restoration system can include placing an upper wheel in an upper housing and inserting a rod through the upper housing and a hole in the upper wheel, thereby securing the upper wheel to the upper housing. The lower wheel can similarly be secured to the lower housing by inserting a rod through the lower housing and a hole in the lower wheel. If two wheel assemblies are desired, similar steps can be taken to secure a second upper wheel and a second lower wheel to a second wheel assembly. In some examples, the rods can have threads that screw into corresponding holes in the upper housing and lower housing, thereby locking the wheels within the housings such that the wheels can only rotate about the rod and not translate in any direction.

[0096] The method **1400** can further include sliding the medical device tray, the first clamp (e.g., first clamp assembly), and second clamp (e.g., second clamp assembly) along the at least one guide rail to ensure that the system is able to slide properly. The method **1400** can further including warming up the heating device.

[0097] At block **1402**, the method **1400** can include placing a body (e.g., handle) of the medical device in a medical device tray of a catheter restoration system. The method **1400** can then include aligning the kinked or damaged portion of a catheter of the medical device with a heat device having a nozzle and a thermal element. If the kinked or damaged portion is close to a body (e.g., handle) of the medical device, a body support (e.g., handle support) can be placed on the medical device tray to better align the kinked or damaged portion of the catheter with the nozzle of the heat device. For example, the body support can be used to move the plane of the catheter closer to the first clamp (e.g., first clamp assembly), as described herein.

[0098] In some examples, if the kinked or damaged portion of the catheter cannot be aligned with the nozzle of the heat device, medical device body can be removed from the medical device tray and inserted in a reverse tray on the opposite side of the catheter restoration system from the medical device tray. In some examples, the reverse tray allows for the kinked or damaged portion of the catheter to be aligned with the nozzle of the heat device.

[0099] Once the kinked or damaged portion is aligned with the nozzle of the heat device, the catheter can be rotated such that the wider sides of the kinked or damaged portion faces directly upward or downward (e.g., is perpendicular to the nozzle of the heat device).

[0100] At block **1404**, the method **1400** can include securing a catheter of the medical device to one or more clamps (e.g., clamp assemblies). The kinked or damaged portion of the catheter can be between a first clamp assembly and a second clamp assembly operable to secure the catheter. Securing the catheter to the one or more clamps can include securing the catheter to a first clamp (e.g., first clamp assembly). The first clamp assembly can have a moveable portion and a fixed portion. The catheter can be placed in a gap between the moveable portion and the fixed portion while a toggle component is in an unlocked position. The toggle component can then be actuated to a locked position. Actuating the toggle component to the locked position can move the moveable portion towards the fixed portion, thereby exerting a force on the catheter and locking the catheter in place. The catheter can then be pulled at a second clamp assembly to ensure tension on the kinked or damaged portion of the catheter. The catheter can be placed in a gap between a moveable portion and fixed portion of the second clamp assembly when a toggle clamp is in an unlocked position. The toggle component can then be actuated to a locked position. Actuating the toggle component to the locked position can move the moveable portion of the second clamp assembly towards the fixed portion, thereby exerting a force on the catheter and locking the catheter in place. Once the catheter is locked in the first clamp assembly and the second clamp assembly with the kinked or damaged portion aligned with the nozzle of the heat device between the clamp assemblies, the catheter has been properly secured.

[0101] The method **1400** can further include lowering an upper wheel of the wheel assembly and aligning the groove of the upper wheel with the catheter. The wheel assembly is located between the first clamp assembly and the second clamp assembly. The upper wheel can be lowered manually, using a toggle clamp to lock and unlock the position of the upper wheel housing, and thereby the upper wheel, along an upper wheel guide rail, as described herein. In other examples, the upper wheel can be lowered electronically using a controller or processor as described herein. Once the groove of the upper wheel and the groove of the lower wheel align with the catheter, the catheter is ready to be provided heated air or gas from the heat device.

[0102] At block **1406**, the method **1400** can include providing heated air or gas to the kinked or damaged portion of the catheter via the heating device.

[0103] The nozzle can provide the heated air or gas to the catheter. The heat device can be configured to provide the heated air or gas for a heating duration sufficient to soften the material of the catheter at the kinked or damaged portion. In some examples, the heating duration can be about 1 second to about 2 seconds, about 2 seconds to about 3 seconds, about 3 seconds to about 4 seconds, about 4 seconds to about 5 seconds, about 5 seconds to about 6 seconds, about 6 seconds to about 7 seconds, about 7 seconds to about 8 seconds, about 8 seconds to about 9 seconds, about 9 seconds to about 10 seconds, or more. In some examples, the heating duration can be about 1 second to about 5 seconds, about 5 seconds to about 10 seconds, about 10 seconds to about 15 seconds, about 15 seconds to about 20 seconds, about 20 seconds to about 25 seconds, about 25 seconds to about 30 seconds, about 30 seconds to about 35 seconds, about 35 seconds to about 40 seconds, about 40 seconds to about 45 seconds, about 45 seconds to about 50 seconds, about 50 seconds to about 55 seconds, about 55 seconds to about 1 minute, or more.

[0104] The thermal element of the heating device can heat the air or gas to a temperature of about 50 degrees Celsius (C) to about 55 degrees C., about 55 degrees C. to about 60 degrees C., about 60 degrees C. to about 65 degrees C., about 65 degrees C. to about 70 degrees C., about 70 degrees C. to about 75 degrees C., about 75 degrees C. to about 80 degrees C., about 80 degrees C. to about 85 degrees C., about 85 degrees C. to about 90 degrees C., about 90 degrees C. to about 95 degrees C., about 95 degrees C. to about 100 degrees C., about 100 degrees C. to about 105 degrees C., about 105 degrees C. to about 110 degrees C., about 110 degrees C. to about 115 degrees C., about 115 degrees C. to about 120 degrees C., about 120 degrees C. to about 125 degrees C., about 125 degrees C. to about 130 degrees C., about 130 degrees C. to about 135 degrees C., about 135 degrees C. to about 140 degrees C., about 140 degrees C. to about 145 degrees C., about 145 degrees C. to about 150 degrees C., about 150 degrees C. to about 155 degrees C., about 155 degrees C. to about 160 degrees C., about 160 degrees C. to about 165 degrees C., about 165 degrees C. to about 170 degrees C., or any range therebetween. The heated air or gas can be operable to soften the material of the catheter at the kinked or damaged portion without melting the material.

[0105] The temperature and the heating duration of the heated air or gas can be determined based on the type of material the catheter is made of. Depending on the type of material a temperature and heating duration can be chosen such that the material softens but does not melt. In some examples, the temperature and duration of the heated air or gas can also depend on the diameter of the catheter.

[0106] At block **1410**, the method **1400** can include receiving the catheter in a forming component of a reforming assembly. The reforming component of the reforming assembly can be operable to reform the softened material of the catheter to a desired diameter. The reforming component can have a diameter substantially equal to the desired diameter of the catheter. In some examples, the reforming component can be a pair of corresponding grooves in a circumference of corresponding rolling wheels. In some examples, the reforming component can be a hole formed by corresponding half-circles of a reforming split mold.

[0107] At block **1412**, the method **1400** can include moving the catheter along a longitudinal axis through the reforming assembly, thereby reforming the catheter. In some examples, moving the catheter along the longitudinal axis through the reforming assembly can include rolling the softened material of the catheter through a pair of rolling wheels, thereby reforming the catheter. Each wheel of the pair of rolling wheels can have a groove that is aligned with the catheter. The grooves can be sized such that they reform the catheter to its intended diameter. Rolling the softened material through the pair of rolling wheels can include translating the catheter back and forth along the at least one guide rail. In some examples, rolling the softened material back and force through the grooves in the pair of wheels provides a force or pressure to the catheter, thereby forming a consistent and uniform diameter by removing any protrusions and filling any indents in the catheter. In some examples, the softened material can be rolled through the pair of rolling wheels by translating the catheter back and forth along the at least one guide rail manually by an operator using handles on the first clamp assembly and the second clamp assembly. In some examples, the catheter can be moved back and forth using a motor or actuator operable to slide the first clamp assembly and second clamp assembly along the at least one guide rail, thereby removing the need for an operator to manually slide the catheter back and forth. In some examples, the at least one guide rail can have end stops to limit the distance that the catheter moves back and forth, thereby ensuring that the kinked or damaged portion of the catheter is rolled through the pair of rolling wheels efficiently.

[0108] In some examples, the catheter restoration system can include one or more markings to indicate to an operator how far to slide the catheter back and forth along the at least one guide rail.
[0109] In some examples, moving the catheter along a longitudinal axis of the reforming assembly can include translating the catheter back and forth through a hole formed by two corresponding half-circle holes of a reforming split mold. The hole formed by the two corresponding half-circle holes of the reforming split mold can have a diameter substantially equal to a desired diameter of the catheter, such that moving the catheter along the longitudinal axis provides a force or pressure to the catheter thereby removing any protrusions and filling any indents. By removing any protrusions and filling any indents, the catheter is reformed to a consistent and uniform diameter.
[0110] In some examples, the soften material is rolled through the pair of rolling wheels one time, two times, three times, four times, five times, six times, seven times, eight times, nine times, ten times, or more.
[0111] At block **1412**, the method **1400** can further include cooling the catheter after the catheter has been reformed by the pair of rolling wheels. In some examples, cooling the catheter can include providing cool air to the catheter via a fan for a cooling duration. In other examples, cooling the catheter can include allowing the catheter to cool at room temperature for a cooling duration. The cooling duration can be about 1 minute to about 10 minutes, about 10 minutes to about 20 minutes, about 20 minutes to about 30 minutes, about 30 minutes to about 40 minutes, about 40 minutes to about 50 minutes, or about an hour. In many examples, providing cooling air with a fan can shorten the cooling duration to about 1 minute to about 5 minutes.
[0112] The method **1400** can further include visually inspecting the catheter.
[0113] Visually inspecting the catheter can include ensuring that the kinked portion or damaged portion of the catheter has been successfully reformed. In other words, visually inspecting the catheter includes ensuring the catheter is fully restored to a desired shape (e.g., diameter). In some examples, if the kinked or damaged portion of the catheter has not been successfully reformed, the method **1400** can be repeated. Further, if the catheter has a second kinked or damaged portion at another location along the length of the catheter, the method **1400** can be repeated for the second kinked or damaged portion.
[0114] The method **1400** can further include inspecting the catheter using one or more sensors. For example, proximity sensors, machine vision sensors, and other types of sensors operable to determine a diameter of a catheter can be used to ensure that the diameter of the catheter has been reformed to a desired diameter within desired tolerances. In some examples, the desired tolerances can be tolerances required for clinical use of the catheter in a patient.
[0115] The method **1400** can further include cleaning the medical device. Cleaning the medical device can include contacting the medical device with a cleaning solution such as isopropyl alcohol or other similar cleaning solutions. The method **1400** can further include sterilizing the medical device. Sterilizing the medical device can include dry heat methods, steam methods, radiation methods, ethylene oxide methods, vaporized hydrogen peroxide methods, and other sterilization methods.
[0116] The disclosures shown and described above are only examples. Even though numerous characteristics and advantages of the present technology have been set forth in the foregoing description, together with details of the structure and function of the present disclosure, the disclosure is illustrative only, and changes may be made in the detail, especially in matters of shape, size and arrangement of the parts within the principles of the present disclosure to the full extent indicated by the broad general meaning of the terms used in the attached claims. It will therefore be appreciated that the examples described above may be modified within the scope of the appended claims.

Claims

1. A system for removing kinks in a catheter of a medical device and/or reforming the catheter of the medical device, the system comprising: at least one clamp operable to secure the catheter; a heat device operable to provide heat to the catheter secured by the at least one clamp; and a reforming assembly including a reforming component operable to receive the catheter of the medical device therein such that when the catheter moves in relation to the reforming assembly along a longitudinal axis, the reforming assembly reforms the catheter and/or removes the kinks from the catheter, wherein the at least one clamp includes a first clamp and a second clamp operable to secure the catheter on opposite sides of the reforming assembly, and wherein the first clamp and the second clamp are operable to move the catheter back and forth along the longitudinal axis.
2. The system of claim 1, wherein the system further comprises a medical device tray operable to hold the medical device, the medical device tray operable to move along the longitudinal axis in coordination with the first clamp and the second clamp.
3. The system of claim 1, wherein the reforming assembly includes at least one pair of rolling wheels, wherein the reforming component includes a groove formed along a circumference of each wheel of the at least one pair of rolling wheels.
4. The system of claim 3, wherein the grooves are operable to contact an exterior surface of the catheter and reform the exterior surface of the catheter.
5. The system of claim 3, wherein the at least one pair of rolling wheels includes a plurality of interchangeable pairs of rolling wheels, wherein each pair of the plurality of interchangeable pairs of rolling wheels has a different groove size.
6. The system of claim 5, wherein each pair of wheels of the plurality of interchangeable pairs of wheels has a marking indicating a size of the groove.
7. The system of claim 1, wherein the heat device is operable to provide heated air to the catheter at a temperature of about 55 degrees C. to about 170 degrees C.
8. The system of claim 7, wherein the heated air is operable to soften the catheter of the medical device.
9. The system of claim 1, the system further comprising at least one guide rail, wherein the at least one clamp is slidably coupled to the at least one guide rail.
10. The system of claim **19**, wherein the first clamp and the second clamp are operable to secure the catheter such that there is tension in the catheter between the first clamp and the second clamp.
11. The system of claim 1, the system further comprising a processor and a display.
12. The system of claim 11, the processor configured to: receive one or more inputs from an operator; display one or more instructions to the operator via the display; and cause the heat device to provide heated air to the catheter.
13. The system of claim 12, wherein the one or more instructions are one or more of choose recipe, connect device, ensure correct device positioning, begin heating, begin rolling, cooling in progress, remove medical device, and confirm medical device restoration.
14. A method for reforming a catheter of a medical device, the method comprising: placing a body of the medical device in a medical device tray; securing the catheter to at least one clamps; providing heated air to at least one kink in the catheter via a heat device, thereby softening a material of the catheter; receiving the catheter in a reforming component of a reforming assembly; and moving the catheter in relation to the reforming assembly along a longitudinal axis, thereby reforming the catheter and/or removing kinks from the catheter, wherein the at least one clamp includes a first clamp and a second clamp operable to secure the catheter on opposite sides of the reforming assembly, and wherein the first clamp and the second clamp are operable to move the catheter back and forth along the longitudinal axis.
15. The method of claim 14, wherein the heated air has a temperature of about 55 degrees C. to about 170 degrees C.

16. The method of claim 15, wherein the heated air is provided for about 5 seconds to about 20 seconds.
17. The method of claim 14, the method further comprising inspecting the catheter.
18. The method of claim 17, the method further comprising repeating the method if the catheter is not fully restored to a desired shape.
19. The method of claim 14, the method further comprising sterilizing the medical device.
20. The method of claim 14, wherein the reforming assembly includes a pair of rolling wheels, wherein the reforming component includes a groove formed along a circumference of each wheel of the pair of wheels.
21. The system of claim 1, wherein the heat device is operable to provide heat to the catheter between (1) the first clamp and the reforming assembly and/or (2) the second clamp and the reforming assembly.
22. The system of claim 3, wherein the at least one pair of wheels includes a pair of vertically aligned wheels.
23. The system of claim 6, wherein the size of the groove corresponds to an outer diameter of the catheter.