METHOD AND APPARATUS FOR SEALING AN OBJECT

A method of sealing an object comprises an apparatus comprising a first member for supporting the object; a second member for clamping the object against the first member, the second member being configured so as to be adjustable between an open position and a close position, wherein in the close position, the second member is adjusted towards the first member for clamping the object, and in the open position, the second member is adjusted away from the first member such that at least a portion of the second member is diagonally offset from a position of said portion of the second member in the close position. For example, the object may be a tube such as a medical tubing.

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FIELD OF INVENTION

The invention generally relates to a method and an apparatus for sealing an object. More particularly, the invention relates to a method and an apparatus for sealing a tube such as plastic medical tubing.

BACKGROUND

Plastic tubing such as polyvinylchloride (PVC) is widely used for the transfer of fluid from one location to another. For example, tubing is used in various medical applications to convey fluid, such as blood from a blood bag, to and from a patient.

Often, plastic tubing needs to be sealed. There are a number of existing devices for sealing plastic tubing. For example, the plastic tubing can be sealed by being inserted between a pair of opposing jaws formed with electrodes whereby the opposing jaws are drawn together in a parallel manner to clamp the tubing placed therebetween. A high frequency energy is then applied to the electrodes to fuse the opposing walls of the tubing together thereby forming a seal.

Figure 9 shows an exemplary prior art device 100 for sealing a plastic tube. The device 100 comprises a pair of opposing jaws (a top jaw 102 and a bottom jaw 103) for sealing the tube and a tube guide 104. The tube guide 104 has a slot 106 for receiving the tube sideways to place the tube between the opposing jaws. In the device 100, the top jaw 102 is fixed. The bottom jaw 103 is pushed towards the top jaw 102 for clamping the tube and drawn away from the top jaw 102 for releasing the tube in a parallel manner by the spring 108 and the solenoid 110.

However, with such a device, the pair of jaws is arranged such that the jaws permanently face each other and both the jaws are drawn together or one of the jaws is drawn towards the other in a parallel manner during clamping. As a result, once the tube is inserted between the jaws, the portion of the tubing intended to be fused together is mostly obstructed from the line of sight of the user or operator by at least one of the jaws. Furthermore, since the tube is inserted and positioned
sideways, the tube may not be safely secured in position between the opposing jaws and thus there is a chance that the tube could be inadvertently moved out of its loaded position.

In addition, with such a device, the tubing may not be clamped consistently with sufficient force during sealing resulting in the formation of a number of seals which are undesirable or unsatisfactory.

The device also does not include any feedback function allowing for the position of the jaw(s) and the operational status of the device to be detected/determined. As a result, the device is not capable of being controlled precisely to achieve various positions of the jaw(s) such as to allow for multiple sealing gap sizes.

The present invention seeks to provide an improved or alternative method and apparatus for sealing a tube in light of the above-discussed prior art.

SUMMARY

In accordance with a first aspect of the present invention, there is provided an apparatus for sealing an object, the apparatus comprising:

a first member for supporting the object;

a second member for clamping the object against the first member, the second member being configured so as to be adjustable between an open position and a close position, wherein

in the close position, the second member is adjusted towards the first member for clamping the object, and

in the open position, the second member is adjusted away from the first member such that at least a portion of the second member is diagonally offset from a position of said portion of the second member in the close position.

Preferably, said portion of the second member is a clamp portion of the second member, the clamp portion being a portion of the second member in contact with the object when clamping the object.

Preferably, the second member is configured to be rotatable about an axis when being adjusted between the open position and the close position.

Preferably, the second member is configured to be adjustable from the open position to the close position in a plurality of stages.
Preferably, the plurality of stages comprises a first stage where the second member is rotated about the axis so as to be directly above the first member and a second stage where the second member is lowered towards the first member along the axis for clamping the tube.

Preferably, the second member is configured to be adjustable from the close position to the open position in a plurality of stages.

Preferably, the plurality of stages comprises a first stage where the second member is lifted from the first member along the axis for releasing the clamping of the tube, a second stage where the second member is rotated about the axis such that said portion of the second member is diagonally offset from the position of said portion at the close position.

Preferably, the plurality of stages further comprises a third stage where the second member is lifted further away from the first member along the axis.

Preferably, the second member extends from a shaft, wherein the axis is a longitudinal axis of the shaft.

Preferably, the shaft comprises a guide pin for interacting with a corresponding guide profile for guiding the second member between the open position and close position.

Preferably, the apparatus further comprises a housing for enclosing the shaft, and wherein the housing comprises the guide profile, and the guide profile is positioned so as to oppose the guide pin.

Preferably, the guide profile is a cut-out portion generally rectangular in shape and comprises a protrusion extending from a lower edge of the cut-out portion.

Preferably, the apparatus further comprises one or more sensors for detecting a location of the guide pin within the guide profile, where the location of the guide pin corresponds to a position of the second member.

Preferably, the one or more sensors are operable to detect the location of the guide pin and generate a positional information based on the detected location of the guide pin.

Preferably, in the close position, the second member is adjusted to clamp the object against the first member with a clamping gap therebetween.
Preferably, a size of the clamping gap in the close position is adjustable by controlling the location of the guide pin within the guide profile based on the positional information.

Preferably, the one or more sensors comprises at least a first sensor and a second sensor, the first and second sensors for detecting whether the second member is in the open position and close position respectively.

Preferably, the apparatus further comprises a motor and a processor, the motor for adjusting the second member via the shaft, and the processor for controlling the motor based on the positional information received.

Preferably, the apparatus further comprises an electric circuit configured for generating a high frequency energy to fuse a portion of the object clamped by the first and second member thereby forming a seal.

Preferably, the object is a tube.

In accordance with a second aspect of the present invention, there is provided a method of sealing an object, the method comprising:

positioning the object on a first member, and
adjusting a second member between an open position and a close position, the second member for clamping the object against the first member, wherein in the close position, the second member is adjusted towards the first member for clamping the object, and
in the open position, the second member is adjusted away from the first member such that at least a portion of the second member is diagonally offset from a position of said portion of the second member in the close position.

Preferably, said portion of the second member is a clamp portion of the second member, the clamp portion being a portion of the second member in contact with the object when clamping the object.

Preferably, said adjusting the second member between the open position and the close position comprises rotating the second member about an axis.

Preferably, said adjusting the second member comprises adjusting the second member from the open position to the close position in a plurality of stages.

Preferably, the plurality of stages comprises a first stage where the second member is rotated about the axis so as to be directly above the first member and a
second stage where the second member is lowered towards the first member along the axis for clamping the tube.

Preferably, said adjusting the second member comprises adjusting the second member from the close position to the open position in a plurality of stages.

Preferably, the plurality of stages comprises a first stage where the second member is lifted from the first member along the axis for releasing the clamping of the tube, a second stage where the second member is rotated about the axis such that said portion of the second member is diagonally offset from the position of said portion at the close position.

Preferably, the plurality of stages further comprises a third stage where the second member is lifted further away from the first member along the axis.

Preferably, the second member extends from a shaft, wherein the axis is a longitudinal axis of the shaft.

Preferably, the shaft comprises a guide pin, and said adjusting the second member further comprises guiding the second member between the open position and close position through the interaction of the guide pin with a corresponding guide profile.

Preferably, the guide profile is a cut-out portion of a housing for enclosing the shaft, and wherein the guide profile is positioned so as to oppose the guide pin.

Preferably, the method further comprises detecting a location of the guide pin within the guide profile, where the location of the guide pin corresponds to a position of the second member.

Preferably, said detecting is performed by one or more sensors.

Preferably, the method further comprises generating a positional information based on the detected location of the guide pin.

Preferably, in the close position, the second member is adjusted to clamp the object against the first member with a clamping gap therebetween, and the method further comprises adjusting a size of the clamping gap in the close position by controlling the location of the guide pin within the guide profile based on the positional information.

Preferably, the method further comprises detecting whether the second member is in the open position and/or whether the second member is in the close position.
Preferably, said adjusting the second member is performed by a motor via the shaft, and the method further comprises controlling the motor based on the positional information received.

Preferably, the method further comprises generating a high frequency energy for fusing a portion of the object clamped by the first and second members thereby forming a seal.

Preferably, the object is a tube.

In accordance with a third aspect of the present invention, there is provided a computer product embodied on a computer readable medium, the computer program comprising a set of instructions executable by a computer for adjusting said second member between an open position and a close position according to the second aspect of the present invention described hereinabove.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1 depicts a side view of the apparatus according to an embodiment of the present invention in a close position;
Figure 2 depicts a front view of the apparatus in the close position;
Figure 3 depicts a top view of the apparatus in the close position;
Figure 4 depicts a side view of the apparatus according to the embodiment in an open position;
Figure 5 depicts a front view of the apparatus in the open position;
Figure 6 depicts a top view of the apparatus in the open position;
Figure 7 is an event sequence diagram illustrating the movement of the guide pin within the cut-out portion between the open and close positions.
Figure 8 depicts a schematic flowchart illustrating a method of sealing an object according to an embodiment of the present invention.
Figure 9 depicts an exemplary prior art device for sealing a plastic tube.

DETAILED DESCRIPTION
According to an embodiment of the present invention, there is provided an apparatus for sealing an object. For the sake of clarity, the present invention will be described with respect to sealing a tube such as a plastic tube made from polyvinylchlorohde (PVC). However, it will be apparent to a person skilled in the art that the present invention is not limited to sealing a tube and may also be used to seal other objects such as a bag.

Plastic tubes are widely used for the transfer of fluid from one location to another in various applications. For example, in medical applications, plastic medical tubes may be used to transfer oxygen from an oxygen tank or blood from a blood bag to a patient in need. Since plastic tubing functions as an inlet/outlet of a storage medium, plastic tubing often needs to be sealed to protect the content of the storage medium.

An example of the apparatus 10 for sealing a tube 14 according to the embodiment of the present invention is illustrated in Figures 1 to 7. The apparatus 10 comprises a first member 12 for supporting the tube 14 thereon and a second member 16 for clamping the tube 14 against the first member 12. For example, the first member 12 is a support platform for supporting the tube 14 thereon and the second member 16 is an arm such as a swivel arm for clamping the tube 14 against the support platform 12. For example, the arm 16 is elongated in shape. The apparatus 10 is configured so as to be adjustable between a close (or clamp) position as illustrated in Figures 1 to 3 and an open (or load) position as illustrated in Figures 4 to 6.

In the close position, the arm 16 is adjusted towards the support platform 12 for clamping the tube 14. For example, the arm 16 is adjusted to be adjacent or in close proximity to the support platform 12 for clamping the tube 14 with a clamping gap 17 therebetween. The size (or width) of the clamping gap 17 is configured to obtain a desired strength of the clamping force on the tube 14 in the close position. In an embodiment, the size of the clamping gap 17 is between about 0.4 mm to about 1 mm, more preferably, about 0.44 mm to about 0.88 mm. In the close position, the apparatus 10 is operable to seal a portion of the tube 14 clamped between the support platform 12 and the arm 16. In an embodiment, the apparatus 10 further comprises an electric circuit 18 for generating high frequency or ultrasonic energy to fuse opposing surfaces of the clamped portion of the tube 14 together thereby forming a seal. In this case, the arm 16 and the support platform 12 are
each formed with an electrode (not shown) and the high frequency energy is applied to the electrodes to fuse the tube 14. The electric circuit 18 may be supported or affixed to a shaft 19 extending from the support platform 12 as shown in Figures 1 and 4. Using high frequency or ultrasonic energy to fuse a tube is well known to a person skilled in the art and thus will not be described in any further detail unless as relevant to the present invention.

In the open position, the arm 16 is adjusted away from the support platform 12 such that the position of at least a portion 15 of the arm 16 at the open position is diagonally offset from the position of the same portion 15 of the arm 16 at the close position. For example, such a portion 15 of the arm 16 is a portion in contact with the tube 14 when the arm 16 clamps the tube 14 against the support platform 12. The portion 15 may be referred to as a clamp portion of the arm 16. Preferably, at the open position, the clamp portion 15 of the arm 16 is diagonally offset from its position at the close position such that the tube can be placed on the support platform 12 from above without being obstructed by the arm 16 as illustrated in Figure 6. As a result, the portion of the tube to be clamped and fused together is not obstructed from the line of sight of a person viewing from above when loaded on the support platform 12 (i.e., is visible from above).

As illustrated in the Figures 1 to 6, the arm 16 extends orthogonally from a shaft 20. For example, the shaft 20 is a swivel. The arm 16 is configured so as to be rotatable about an axis (i.e., the longitudinal axis) 21 of the shaft 20. The shaft 20 comprises a threaded portion 24 adapted to engage with a corresponding threaded member 26. The threaded portion 24 and the threaded member 26 are configured to engage each other with sufficient friction such that the turning of the threaded member 26 clockwise or anti-clockwise will cause the shaft 20 to turn correspondingly as long as the shaft 20 is not obstructed from turning. However, when the shaft 20 is obstructed from turning, the threaded portion 24 and the threaded member 26 will interact in a screw-like manner causing the shaft 20 to move upwards or downwards depending on whether the threaded member 26 is turned clockwise or anti-clockwise.

In an embodiment, the apparatus 10 further comprises a motor 22 for turning the threaded member 26 so as to adjust the arm 16 between the open and close positions.
In an embodiment, the shaft 20 comprises a guide pin 28 to control or guide the movement of the arm 16 between the open and close positions. In this case, the guide pin 28 engages with a guide profile 30 defining an area 32 where the guide pin 28 is permitted to move (and thus defines the corresponding permitted movement of the arm 16).

Preferably, the apparatus 10 further comprises a housing 34 for enclosing the shafts 19 and 20. In this case, the guide profile 30 is preferably a cut-out portion 36 in the housing 34 at a section opposing or facing the guide pin 28 as illustrated in Figures 1 to 2 and 4 to 5. The cut-out portion 36 is shaped to achieve a desired movement of the arm 16 between the open and close positions through its interaction with the guide pin 28 of the shaft 20.

The movement of the guide pin 28 within the cut-out portion 36 as the arm 16 moves between the open and close positions will be described in further detail below with reference to Figure 7.

Figure 7 is an event sequence diagram illustrating the movement of the guide pin 28 within the cut-out portion 36 as the arm 16 moves from the open position to the close position and from the close position to the open position.

As shown in Figure 7, the cut-out portion 36 according to an embodiment of the present invention is generally in the shape of a square or rectangle with a protrusion or a kink 38 extending from a lower edge 36c of the cut-out portion 36. It will be apparent to a person skilled in the art that the present invention is not limited to such a shape and the shape can be modified depending on various factors such as to achieve a desired movement of the arm 16.

First, the movement of the guide pin 28 as the arm 16 moves from the open position to the close position will be described. The movement of the guide pin 28 from the open position to the close position can be classified into a plurality of steps or stages. When the arm 16 is at the open position, the guide pin 28 is located at the upper right corner of the cut-out portion 36 as shown in Figure 7. A top view of the arm 16 at this open position is shown in Figure 6. As shown, at least a portion of the arm 16, in particular the clamp portion 15, is diagonally offset from the support platform 12 such that the tube 14 can be placed on the support platform 12 from directly above thereof without being obstructed by the arm 16. Furthermore, the portion of the tubing to be fused together is not obstructed from the line of sight of a person viewing from above.
To adjust the arm 16 to the close position, the threaded member 26 is turned clockwise when viewed from above in the direction of the axis 21 of the shaft 20. Unless otherwise stated, the terms "clockwise" and "anti-clockwise" are the directions when viewed from above in the direction of the axis of the shaft 20. The threaded portion 24 and the threaded member 26 are configured to engage each other with sufficient friction such that the turning of the threaded member 26 clockwise or anti-clockwise will cause the shaft 20 to turn correspondingly as long as the shaft 20 is not obstructed from turning. Accordingly, turning the threaded member 26 clockwise when the guide pin 28 is located at the upper right corner of the cut-out portion 36 will correspondingly turn the shaft 20 clockwise resulting in the guide pin 28 moving to the upper left corner of the cut-out portion 36 as shown in Figure 7. When the guide pin 28 is at this position, the arm 16 is moved to be directly above the support platform 12 as shown in Figure 3.

The left edge 36b of the cut-out portion 36 determines the extent to which the arm 16 is able to rotate. In this embodiment, the left edge 36b is configured such that it prevents the arm 16 from rotating further (via the guide pin 28) once the arm 16 is positioned directly above the support platform 12 as shown in Figure 3. The movement of the guide pin 28 from the upper right corner to the upper left corner of the cut-out portion 36 may be referred to as a first stage of the above-mentioned plurality of stages.

As the threaded member 26 is turned further clockwise, the shaft 20 (and thus the arm 16) will not be able to rotate clockwise any further since the guide pin 28 is prevented from moving beyond the left edge 36b of the cut-out portion 36. As a result, the threaded portion 24 of the shaft 20 and the threaded member 26 will interact in a screw-like manner causing the shaft 20 to be drawn downwards thus lowering the arm 16 towards the support platform 12. As the shaft 20 is moved downwards, the guide pin 28 moves downwards along the left edge 36b until it engages with the lower edge 36c as shown in Figure 7 which prevents the shaft 20 from being lowered further. At this point, the arm 16 clamps down onto the tube 14 against the support platform 12 with sufficient force or a predetermined force (based on a width of the gap 17 between the arm 16 and the support platform 12 at the close position) to enable a satisfactory seal to be formed. A top view of the arm 16 at the close position is shown in Figure 3. As shown, the arm 16 is directly above the
support platform 12 for sealing the tube 14. Preferably, at this position, a longitudinal
axis of the arm 16 is orthogonal to a longitudinal axis of the tube 14.

The width of the gap 17 depends on the distance the guide pin 28 is able to
move downwards along the left edge 3b. For example, if a smaller width (thus
greater force) is desired, a portion 36c' of the lower edge 36c can be lowered so as
to allow the guide pin 28 to travel further down along the left edge 36b. On the other
hand, if a larger width (thus less force) is desired, the portion 36c' of the lower edge
36c can be raised so as to reduce the distance the guide pin 28 can travel
downwards along the left edge 36b. The movement of the guide pin 28 from the
upper left corner to the lower left corner of the cut-out portion 36 may be referred to
as a second stage of the above-mentioned plurality of stages.

At the close position, the clamped portion of the tube 14 is fused together by
applying high frequency or ultrasonic energy thereto for forming a seal.

Now, the movement of the guide pin 28 as the arm 16 moves from the close
position to the open position will be described with reference to Figure 7. The
movement of the guide pin 28 from the close position to the open position can also
be classified into a plurality of steps or stages.

When the arm 16 is at the close position, the guide pin 28 is at the lower left
corner as shown in Figure 7. The arm 16 is adjusted to the open position by turning
the threaded member 26 anti-clockwise. When the threaded member 26 is turned
anti-clockwise, the shaft 20 is obstructed from turning clockwise due to the guide pin
28 encountering a left edge 40 of the protrusion 38 as shown in Figures 2 and 7. As
a result, the threaded portion 24 of the shaft 20 and the threaded member 26 will
interact in a screw-like manner causing the shaft 20 to be drawn upwards thus lifting
the arm 16 away from the support platform 12. The arm 16 will continue to lift until
the guide pin 28 rises above the protrusion 38 as shown in Figure 7 such that the
guide pin 28 is no longer obstructed from turning anti-clockwise (to the right in
Figure 7). The length (or height) of the left edge 40 of the protrusion 38 (i.e., the
peak of the protrusion 38) is configured such that the arm 16 rises sufficiently above
the support platform 12 to release the clamp. The movement of the guide pin 28
from the lower left corner of the cut-out portion 36 to the peak of the protrusion 38
may be referred to as a first stage of the above-mentioned plurality of stages.

When the guide pin 28 is at the peak of the protrusion 38, turning the
threaded member 26 anti-clockwise will cause the shaft 20 to turn correspondingly
-anti-clockwise since the shaft 20 is no longer obstructed from turning. The arm 16 will continue to turn anti-clockwise in line with the threaded member 26 until the guide pin 28 encounters the right edge 36d of the cut-out portion 36 as shown in Figure 7. At this point, the right edge 36d prevents the guide pin 28 from turning anti-clockwise further and thus the arm 16 is prevented from turning further anti-clockwise. In an embodiment, the shaft 20 is rotated in the range of about 60 to 90 degrees with respect its longitudinal axis 21, more preferably in the range of about 65 to 80 degrees. The movement of the guide pin 28 from the peak of the protrusion 38 to the right edge 36d may be referred to as a second stage of the above-mentioned plurality of stages.

As the threaded member 26 is turned anti-clockwise further, the shaft 20 is unable to rotate anti-clockwise (to the right in Figure 7) any further due to the guide pin 28 encountering the right edge 36d. As a result, the threaded portion 24 of the shaft 20 and the threaded member 26 will interact causing the shaft 20 to be drawn upwards thus lifting the arm 16 further away from the support platform 12.

Accordingly, the movement of the arm 16 with respect to the support platform 12 between the open position for loading the tube 14 and the close position for clamping and sealing the tube 14 have been described above with respect to the guide pin 28 and guide profile 30 as illustrated in Figure 7. In an embodiment, the clamp portion 15 of the arm 16 at the open position is diagonally offset from its position at the close position in the range of about 60 to 90 degrees, more preferably 65 to 80 degrees, with respect to its axis of rotation (i.e., the axis 21 of the shaft 20). It will be apparent to the person skilled in the art that the shape of the guide profile 30 can be modified depending on various factors such as to achieve a desired movement of the arm 16. For example, the peak of the protrusion 38 can be higher or lower depending of the amount of lift desired after clamping and prior to the arm 16 swinging away.

In an embodiment, the apparatus 10 further comprises one or more sensors for detecting the location of the guide pin 28 in the cut-out portion 36 and thus the corresponding position of the arm 16 and the operational status of the apparatus 10. In an embodiment, the apparatus 10 may comprise a first sensor 44 and a second sensor 46 adjacent or in proximity of the upper right corner and lower left corner of the cut-out portion 36, respectively. The first sensor 44 detects whether the guide pin 28 is located at the upper right corner and the second sensor 46 detects whether
The guide pin 28 is located at the lower left corner of the cut-out portion 36. The first and second sensors 44, 46 are operable to generate signals based on a result of the above-mentioned detection and are communicatively coupled to the motor 22 for controlling the operations of the motor 22.

In an embodiment, the apparatus 10 further comprises or is communicatively coupled to a computer processor 50 for controlling the operations of the motor 22 based on a signal received from the sensors so as to achieve the movement of the arm 16 described hereinbefore from the open position to the close position and vice versa. For example, when the first sensor 44 detects that the guide pin 28 is located at the upper right corner of the cut-out portion 36, the first sensor 44 sends a signal to the processor 50 for stopping the motor 22 from continuing to turn the threaded member 26 as the arm 16 is at the desired open position. Accordingly, based on the signal, the processor 50 is able to determine the position of the arm 16 and that the operational status of the apparatus 10 is at the open (or release) position. As another example, when the second sensor 46 detects that the guide pin 28 is located at the lower left corner of the cut-out portion 36, the second sensor 46 sends a signal to the processor 50 for stopping the motor 22 from continuing to turn the threaded member 26 as the arm 16 is at the desired close position. Accordingly, based on the signal, the processor 50 is able to determine the position of the arm 16 and that the operational status of the apparatus 10 is at the close (or clamp) position.

In an embodiment, the sensor 46 is operable to detect the position of the guide pin 28 in the vicinity of the lower left corner of the cut-out portion 36. As described hereinbefore, the size of the gap 17 between the support platform 12 and the arm 16 at the close position determines clamping force applied to the tube therebetween. The size of the gap 17 depends on the distance the guide pin 28 is able to move downwards along the left edge 36b of the cut-out portion 36. Accordingly, the size of the gap 17 can be adjusted by extending or reducing the distance the guide pin 28 travels along the left edge 36b. In this regard, the sensor 46 is operable to detect the position of the guide pin 28 in the vicinity of the lower left corner of the cut-out portion 36 and generate positional information based on the detected position of the guide pin 28. The processor 50 is operable to receive the positional information and control the motor based on the positional information received. For example, the processor may receive a desired size of the gap 17 as an input and the processor is operable to stop the motor 22
when the positional information received by the processor corresponds to the
desired size of the gap 17. Therefore, the processor is operable to control the motor
based on the positional information received. As a result, in the apparatus 10
according to this embodiment, the size of the gap 17 at the close position can be
adjusted as desired so as to, for example, adjust the strength of the clamping force
on the tube 14. Preferably, the size of the gap 17 can be adjusted between about
0.4 to 1 mm, more preferably, about 0.44 to 0.88 mm.

In an alternative embodiment, the apparatus 10 comprises one or more
sensors operable to detect the position of the guide 28 in the cut-out portion 36 and
generate positional information based on the detected position. Based on the
positional information received, the processor is operable to determine the
operational status of the apparatus 10 such as whether the apparatus 10 is at the
close (or clamp) position or at the open (or release) position, or any state
therebetween. Accordingly, the processor 50 is operable to control the motor 22 for
controlling the movement of the arm 16 between the open and close positions based
on the positional information received from the one or more sensors.

Figure 8 is a schematic flowchart 200 illustrating an exemplary method of sealing
an object according to an embodiment of the present invention. For example, the object
may be a tube. The method comprises a step 202 of positioning the tube 14 on a first
member 12 (e.g., the support platform), and adjusting 204 a second member 16 (e.g.,
the arm) between an open position and a close position, the second member 16 for
clamping the tube against the first member 12. In the close position, the second
member 16 is adjusted towards the first member 12 for clamping the tube 14. In the
open position, the second member 16 is adjusted away from the first member 12
such that at least a portion of the second member 16 is diagonally offset from a
position of such a portion of the second member 16 in the close position. Adjusting
the arm 16 between an open (or release) position and a close (or clamp) position
has been described hereinbefore and will not be repeated for conciseness.

It would be apparent to the person skilled in the art that the method of sealing
the tube 14 as described hereinbefore may be put into effect by a computer program
comprising computer code or instructions executable by the computer processor 50.
Further, the method or process can be repeated continuously so as to seal multiple
tubes or portions thereof. The computer program is not limited to any particular
programming language and implementation thereof. Accordingly, in this
embodiment, the apparatus further comprises or is communicatively coupled to a storage medium such as a memory device for storing the computer program executable by the processor.

Alternatively, the movement of the arm 16 described hereinbefore between the open and close positions may be put into effect by hardware modules. More particularly, in the hardware sense, a module is a functional hardware unit designed for use with other components or modules. For example, a module may be implemented using discrete electronic components, or it can form a portion of an entire electronic circuit such as an Application Specific Integrated Circuit (ASIC).

Numerous other possibilities exist. Those skilled in the art will appreciate that a combination of hardware and software modules may be used.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.
CLAIMS

1. An apparatus for sealing an object, the apparatus comprising:
   a first member for supporting the object;
   a second member for clamping the object against the first member, the
   second member being configured so as to be adjustable between an open position
   and a close position, wherein
   in the close position, the second member is adjusted towards the first
   member for clamping the object, and
   in the open position, the second member is adjusted away from the first
   member such that at least a portion of the second member is diagonally offset from
   a position of said portion of the second member in the close position.

2. The apparatus according to claim 1, wherein said portion of the second
   member is a clamp portion of the second member, the clamp portion being a portion
   of the second member in contact with the object when clamping the object.

3. The apparatus according to claim 1 or 2, wherein the second member is
   configured to be rotatable about an axis when being adjusted between the open
   position and the close position.

4. The apparatus according to any one of claims 1 to 3, wherein the second
   member is configured to be adjustable from the open position to the close position in
   a plurality of stages.

5. The apparatus according to claim 4, wherein the plurality of stages
   comprises a first stage where the second member is rotated about the axis so as to
   be directly above the first member and a second stage where the second member is
   lowered towards the first member along the axis for clamping the tube.

6. The apparatus according to any one of claims 1 to 3, wherein the second
   member is configured to be adjustable from the close position to the open position in
   a plurality of stages.
7. The apparatus according to claim 6, wherein the plurality of stages comprises a first stage where the second member is lifted from the first member along the axis for releasing the clamping of the tube, a second stage where the second member is rotated about the axis such that said portion of the second member is diagonally offset from the position of said portion at the close position.

8. The apparatus according to claim 7, wherein the plurality of stages further comprises a third stage where the second member is lifted further away from the first member along the axis.

9. The apparatus according to any one of claims 1 to 8, wherein the second member extends from a shaft, wherein the axis is a longitudinal axis of the shaft.

10. The apparatus according to any one of claims 1 to 9, wherein the shaft comprises a guide pin for interacting with a corresponding guide profile for guiding the second member between the open position and close position.

11. The apparatus according to claim 10, wherein the apparatus further comprises a housing for enclosing the shaft, and wherein the housing comprises the guide profile, and the guide profile is positioned so as to oppose the guide pin.

12. The apparatus according to claim 11, wherein the guide profile is a cut-out portion generally rectangular in shape and comprises a protrusion extending from a lower edge of the cut-out portion.

13. The apparatus according to any one of claims 10 to 12, wherein the apparatus further comprises one or more sensors for detecting a location of the guide pin within the guide profile, where the location of the guide pin corresponds to a position of the second member.

14. The apparatus according to claim 13, wherein the one or more sensors are operable to detect the location of the guide pin and generate a positional information based on the detected location of the guide pin.
15. The apparatus according to claim 14, wherein in the close position, the second member is adjusted to clamp the object against the first member with a clamping gap therebetween.

16. The apparatus according to claim 15, wherein a size of the clamping gap in the close position is adjustable by controlling the location of the guide pin within the guide profile based on the positional information.

17. The apparatus according to any one of claims 14 to 16, wherein the one or more sensors comprises at least a first sensor and a second sensor, the first and second sensors for detecting whether the second member is in the open position and close position respectively.

18. The apparatus according to any one of claims 14 to 17, wherein the apparatus further comprises a motor and a processor, the motor for adjusting the second member via the shaft, and the processor for controlling the motor based on the positional information received.

19. The apparatus according to any one of claims 1 to 18, wherein the apparatus further comprises an electric circuit configured for generating a high frequency energy to fuse a portion of the object clamped by the first and second member thereby forming a seal.

20. The apparatus according to any one of claims 1 to 20, wherein the object is a tube.

21. A method of sealing an object, the method comprising:
   positioning the object on a first member, and
   adjusting a second member between an open position and a close position,
   the second member for clamping the object against the first member, wherein
   in the close position, the second member is adjusted towards the first member for clamping the object, and
in the open position, the second member is adjusted away from the first member such that at least a portion of the second member is diagonally offset from a position of said portion of the second member in the close position.

22. The method according to claim 21, wherein said portion of the second member is a clamp portion of the second member, the clamp portion being a portion of the second member in contact with the object when clamping the object.

23. The method according to claim 21 or 22, wherein said adjusting the second member between the open position and the close position comprises rotating the second member about an axis.

24. The method according to any one of claims 21 to 23, wherein said adjusting the second member comprises adjusting the second member from the open position to the close position in a plurality of stages.

25. The method according to claim 24, wherein the plurality of stages comprises a first stage where the second member is rotated about the axis so as to be directly above the first member and a second stage where the second member is lowered towards the first member along the axis for clamping the tube.

26. The method according to any one of claims 21 to 23, wherein said adjusting the second member comprises adjusting the second member from the close position to the open position in a plurality of stages.

27. The method according to claim 26, wherein the plurality of stages comprises a first stage where the second member is lifted from the first member along the axis for releasing the clamping of the tube, a second stage where the second member is rotated about the axis such that said portion of the second member is diagonally offset from the position of said portion at the close position.

28. The method according to claim 27, wherein the plurality of stages further comprises a third stage where the second member is lifted further away from the first member along the axis.
29. The method according to any one of claims 21 to 28, wherein the second member extends from a shaft, wherein the axis is a longitudinal axis of the shaft.

30. The method according to any one of claims 21 to 29, wherein the shaft comprises a guide pin, and said adjusting the second member further comprises guiding the second member between the open position and close position through the interaction of the guide pin with a corresponding guide profile.

31. The method according to claim 30, wherein the guide profile is a cut-out portion of a housing for enclosing the shaft, and wherein the guide profile is positioned so as to oppose the guide pin.

32. The method according to claim 30 or 31, further comprising detecting a location of the guide pin within the guide profile, where the location of the guide pin corresponds to a position of the second member.

33. The method according to claim 32, wherein said detecting is performed by one or more sensors.

34. The method according to claim 32 or 33, further comprising generating a positional information based on the detected location of the guide pin.

35. The method according to claim 34, wherein in the close position, the second member is adjusted to clamp the object against the first member with a clamping gap therebetween, and the method further comprises adjusting a size of the clamping gap in the close position by controlling the location of the guide pin within the guide profile based on the positional information.

36. The method according to claim 34 or 35, further comprising detecting whether the second member is in the open position and/or whether the second member is in the close position.
37. The method according to any one of claims 34 to 36, wherein said adjusting the second member is performed by a motor via the shaft, and the method further comprises controlling the motor based on the positional information received.

38. The method according to any one of claims 21 to 37, further comprising generating a high frequency energy for fusing a portion of the object damped by the first and second members thereby forming a seal.

39. The method according to any one of claims 21 to 38, wherein the object is a tube.

40. A computer program product embodied on a computer readable medium, the computer program comprising a set of instructions executable by a computer for adjusting said second member between an open position and a close position according to any one of claims 21 to 39.
positioning a tube 14 on a first member 12

adjust a second member 16 between an open position and a close position

FIG 8
### A. CLASSIFICATION OF SUBJECT MATTER

Int. CI.

**B29C 65/78** (2006.01)

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

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practicable, search terms used)


### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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* Further documents are listed in the continuation of Box C

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**Notes:**

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- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search: 05 December 2011

Date of mailing of the international search report: 07.12.2011

Name and mailing address of the ISA/AU:

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaustralia.gov.au
Facsimile No: +61 2 6283 7999

Authorized officer:

HONG YU

AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No: +61 2 6283 7946
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