Compact Handheld Tube Sealers

FIELD OF THE INVENTION

The invention relates generally to a series of tube sealing methods, with a portable handheld tube sealer variation for sealing Polyvinyl Chloride (PVC) and a miniaturized desktop variation for Thermoplastic Elastomer (TPE) Tubing, both which typically contain biological content such as blood and body fluids to seal off the ends and/or to separate biological samples by sealing the tube into multiple sections for testing to ensure the samples are not exposed to air which might cause contaminations.

BACKGROUND OF THE INVENTION

Radio Frequency (RF) tube sealers are often used in blood centers and blood donation drives to close off the blood bags when they are filled. The scoring line at the seal point is to facilitate the easy separation of the blood bags while still maintaining the seal. The tube sealers are also used to segment the blood-filled blood bag tubing into small sections for different testing procedures in order to check if the blood is safe for use by the recipients of the blood.

There is also an increasing need of such tube sealers in the biotech industry where stem cells, cultured mediums, and other types of fluids are transferred in a similar manner through tubing and bags. Like the blood bags, samples are also required to be taken for testing and quality control measures. However, unlike blood bags, some of the tubing materials are not PVC or having dielectric properties. Tube material used are mainly Thermoplastic elastomer or TPE where a RF tube sealer cannot perform a sealing. Thermal tube sealers are used for such TPE tubes.

Thermal tube sealers work generally by having heating elements in the sealing surfaces by direct conduction. Both sides of the sealing surfaces comes together and with a controlled clamping force, the walls of the tubing comes together and fuses with each other to form a seal.

Both types of sealers are usually large and bulky desktop models, especially the thermal tube sealers which requires high energy inputs to achieve and maintain the temperature. Having portable and miniaturized tube sealers will thus increase the mobility of users in introduction of services and minimizes the locational constraints to use such devices. There is also a need for facilities that use such devices to seal multiple segments of a tube at once, and the jaws of

each sealer used often need to be changed due to wear and tear, as well as to accommodate tubes of different diameters. Traditional means of performing such tasks require much time and effort in sealing multiple sections one at a time for the former, and requires meticulous dismantling of the device to perform maintenance and changing of parts for the latter. As such, additional functionality in the form of a modular multi-sealing set-up as well as the ability to change jaw clamps easily would greatly improve user experience as well.

SUMMARY OF INVENTION

The invention comprises of at least a RF hand gun with a portable RF control unit for the RF tube sealer, as well as a thermal hand gun with a thermal control unit for the thermal tube sealer.

In general, both types of tube sealers use heat generated or heat supplied to the tube, as well as clamping forces to bond the walls of the tubes together to achieve a seal. The fixed and moving clamp jaws of both the RF and thermal hand gun are to be made of hardened metal to minimize wear and tear from repeated usage. The design of the jaws optimizes the sealing properties of the jaws while preventing the denaturing of the medium in the tube during the sealing process. A scoring feature on the moving jaws also provides a scoring mark on the tubes after sealing to enable easy separation of the sealed tubes. Both the RF and thermal hand gun also come with a convenient interchangeable moving clamp jaw system through a press and drop method; having to replace the RF moving jaw due to wear and tear and to accommodate for different tube diameters for the thermal tube sealer.

The RF control unit of the sealer has an internal battery and has been designed to be highly compact compared to traditional models, enabling it to be portable and easy to use for users on the go.

The thermal tube sealer utilizes a compact thermal handgun and compact thermal control unit that minimizes space taken up on the workspace, as well as enables easier shifting of the sealer when needed. In addition to its interchangeable jaw sizes, the thermal handgun has an additional adjustment dial to fine-tune the clamp width for more precise clamping dimensions.

As fluid samples typically require multiple tests to be performed on small amounts of a sample, a modular multi-sealing set-up can be used as well for the RF tube sealer to produce multiple small sections of consistent size. Multiple units can be linked together in a desktop configuration to enable multiple small sections of a single tube to be sealed at one time. This is

done through the use of a hand activated mechanism on the device to trigger the sealing mechanism on each unit simultaneously. The modular multi-sealing set-up can come in the form of linkable charging docks for the portable RF tube sealer and in the form of a linkable tower RF tube sealer module.

BRIEF DESCRIPTION OF FIGURES

In order that the invention may be fully understood and readily put into practical effect there shall now be described by way of non-limitative example only exemplary embodiments of the present invention, the description being with reference to the accompanying illustrative drawings.

FIG. 1 showcases the compact tube sealers 10.

FIG. 2A is a perspective top view of an exemplary embodiment of a RF tube sealer 20, showcasing a RF hand gun 21, a portable RF controller unit 22, and a detachable power cord 23.

FIG. 2B is a perspective top view of the RF hand gun 21, with a hand gun enclosure 210 and an internal clamping mechanism 40.

FIG. 2C is a perspective top view of the portable RF control unit 22 which comprises of an unit enclosure 220, a battery pack 221, a control circuit 222, a power button with indicator lights 223, a power connector port 224, a power supply input port 225.

FIG. 3A is a perspective top view of an exemplary embodiment of a thermal tube sealer 30, showcasing a thermal hand gun 31, a compact thermal controller unit 32, and detachable power cords 33.

FIG. 3B is a perspective top view of the thermal hand gun 31, with a hand gun enclosure 310, an internal clamping mechanism 40, and an adjustment dial 311.

FIG. 3C is a perspective top view of the thermal controller unit 32, with a controller unit enclosure 320, a power button 321, a temperature and timer controller circuit board 322, a temperature and timer adjuster knobs 323, a display panel 324, and a buzzer 325.

FIG. 4A is a perspective top view of an internal clamping mechanism 40, with a moving jaw 41, fixed jaw 42, mechanism base 43, trigger handle 44, and jaw enclosure 45.

FIG. 4B is a perspective top view of a moving jaw 41, showcasing its scoring feature 411 and pin hook 412.

FIG. 5A is a perspective right cross-section view of the internal clamping mechanism 40 in an open configuration A1 with the moving jaw 41 and fixed jaw 42 at a distance from each other and spring 431 uncompressed. The dowel rod 432, moving jaw pin 440, pin hook 412, and trigger handle 44 can be seen as well, with the limit switch 433 unactivated. It depicts the before state of the mechanism clamping onto and sealing a tube via depression of the trigger handle 44.

FIG. 5B is a perspective right cross-section view of the internal clamping mechanism 40 in a closed configuration A2 with the moving jaw 41 and fixed jaw 42 in close contact with each other and spring 431 is compressed. The dowel rod 432, moving jaw pin 440, pin hook 412, and trigger handle 44 can be seen as well, with the limit switch 433 activated. It depicts the after state of the mechanism clamping onto and sealing a tube via depression of the trigger handle 44.

FIG. 6A is a perspective right cross-section view of the internal clamping mechanism 40 in rest configuration B1 for change of moving jaws. The moving jaw 41 is seen in contact with trigger handle 44 via the pin hook 412 and moving jaw pin 440 respectively, while spring 431 is uncompressed.

FIG. 6B is a perspective right cross-section view of the internal clamping mechanism 40 in pushed configuration B2 for change of moving jaws. This details the after effects of a push effort on the moving jaw 41 that is now disconnected from trigger handle 44 via the pin hook 412 and moving jaw pin 440 respectively, and spring 431 is compressed.

FIG. 6C is a perspective right cross-section view of the internal clamping mechanism 40 in dropped configuration B3 for change of moving jaws. This details the trigger handle 44's position after it is dropped from configuration B2, with pin hook 412 now above the moving jaw pin 440 and spring 431 remaining compressed.

FIG. 6D is a perspective right cross-section view of the internal clamping mechanism 40 in released configuration B4 for change of moving jaws. This details the release of the moving jaw 41 from the main internal clamping mechanism 40, with spring 431 now uncompressed

FIG. 7A details the use case from rest configuration B1 of the internal clamping mechanism 40 to its pushed configuration B2.

FIG. 7B details the use case from pushed configuration B2 of the internal clamping mechanism 40 to dropped configuration B3.

FIG. 7C details the use case from dropped configuration B3 of the internal clamping mechanism 40 to released configuration B4.

FIG. 7D details the final released configuration B4 where the moving jaw 41 is now released from the internal clamping mechanism 40.

FIG. 8A is a perspective right cross-section view of the internal clamping mechanism 40 in extended configuration D1 for adjustment of jaw width. The moving jaw 41 is seen at a distance from the fixed jaw 42 and in contact with the adjustment dial 311 at their respective ends.

FIG. 8B is a perspective right cross-section view of the internal clamping mechanism 40 in retracted configuration D2 for adjustment of jaw width. The moving jaw 41 is seen closer to the fixed jaw 42, with both the fixed haw 42 and the adjustment dial 311 having shifted to the left.

FIG. 9 is a perspective top view of the RF tube sealer 20 in a possible carrying configuration C, where the RF tube sealer 20 is placed in a sling pouch 24.

FIG. 10A is a perspective right view of the RF tube sealer 20 in a charging configuration E when placed on a linkable charging dock 25. A hand activated mechanism 50, and female port 51 can be seen with the jaw of 21 exposed facing up.

FIG. 10B is a perspective left view of the RF tube sealer 20 in a charging configuration E when placed on a stackable charging dock 25, where a male port 52 and input power port 53 can be seen.

FIG. 10C is a left cross-section view of the RF tube sealer 20 in a charging configuration E when placed on a stackable charging dock 25, with a triggering mechanism 251 and charging point 252.

FIG. 10D is a perspective top view of multiple RF tube sealers 20 on charging docks 25 in a linked configuration F.

FIG. 11A is a perspective right view of a linkable tower RF tube sealer 26. A hand activated mechanism 50, and female port 51 can be seen.

FIG. 11B is a perspective left view of linkable tower RF tube sealer 26, where a male port 52 and input power port 53 can be seen.

FIG. 11C is a perspective top view of multiple linkable tower RF tube sealers 26 in a linked configuration G.

DETAILED DESCRIPTION OF THE INVENTION

Exemplary embodiment of compact tube sealers 10 will be described below with reference to FIGS. 1 to 11C. The same reference numerals are used throughout the figures for the same or similar parts.

In general, the compact tube sealers 10 can be in the forms of a portable RF tube sealer 20 and a compact thermal tube sealer 30, as seen in FIG. 2A and FIG. 3A respectively. 20 is meant to seal tubes of dielectric properties while 30 is meant to seal thermoplastic tubes. 10 is used to seal these tubes while forming a scoring line for easy separation of each segment of the sealed tubes via an internal clamping mechanism 40.

20 comprises of a RF handgun 21, portable RF control unit 22, and a detachable power cord 23 as seen in FIG. 2A. As seen from FIG. 2B and 2C respectively, 21 consists of a hand gun enclosure 210 along with 40; 22 comprises of an unit enclosure 220, a battery pack 221, a control circuit 222, a power button with indicator lights 223, a power connector port 224, a power supply input port 225. The design of 21 is ergonomically designed for females, who are the majority operating the tube sealers. The design of 22 on the other hand enables it to be portable via its compact size as well as the presence of 221. This thus provides users with a means of easily sealing tubes of dielectric properties at multiple locations without having to transport heavy equipment around.

30 comprises of a thermal handgun 31, compact thermal control unit 32, and a detachable power cords 33 as seen in FIG. 3A. As seen from FIG. 3B and 3C respectively, 31 consists of a hand gun enclosure 310 and an adjustment dial 311 in addition to 40; 32 comprises of a

controller unit enclosure 320, a power button 321, a temperature and timer controller circuit board 322, a temperature and timer adjuster knobs 323, a display panel 324, and a buzzer 325. The compact design of 32 enables it to take up less table space when in use compared to traditional devices, thereby minimizing risks in facilities such as laboratories where the device could be used. The presence of 323 and 324 contributes to ease of use due to the need for fine adjustments of the thermal sealer's settings when used on different types of tubes. 325 contributes to safety measures as well by alerting users when the sealing process is complete, thereby minimizing accidental overuse that may cause damages to the tubes and fluid samples within.

As seen in FIG. 4A, 40 consists of a moving jaw 41, fixed jaw 42, mechanism base 43, trigger handle 44, and jaw enclosure 45. 41 has a scoring feature 411 and pin hook 412 as seen in FIG. 4B. Within 43 there is a spring 431, dowel rod 432, and limit switch 433 as seen in FIG. 5A and 5B, and within 44 there is a moving jaw pin 440. In order to perform a seal for both 20 and 30, 44 is depressed, thereby shifting 440 through contact with 412 and causing 41 to move towards 42 and clamp the tube placed between them. 41 thus forces 432 towards 433 and activates it while compressing 431. 433's activation causes the RF signals and thermal energy in 20 and 30 respectively to pass through 41 and 42, causing the compressed tube material to reach glass transition temperature. A thin homogenous layer with a thinner region known as a scoring line in the middle will be formed at the clamping region due to the presence of 411. This region is subsequently frozen back to solid state after the respective circuits have run their course. The scoring mark enables the tube segments to be easily separated as needed.

40 in both 20 and 30 also provides the opportunity to have interchangeable jaws to easily replace worn out 41, and in the case of 30, change different sizes of 41 to accommodate tubes of different sizes. The changing of 41 is done through a push and drop system, as seen in FIG. 6A to FIG. 6D, with use case seen in FIG. 7A to 7D. 41 is held within 40 via 431 applying force on its end with 440 keeping it in place via 412. With 40 in the original rest configuration B1, users push on 41 such that 412 is disconnected from 440, compressing 431. This shifts 40 to pushed configuration B2. 44 is dropped from its original position while maintaining 41's position such that 440 is now positioned below 412, forming dropped configuration B3 with 431 still compressed. 41 is thus able to slide out of 40 as there is no longer any mechanism holding it, forming released configuration B4 and uncompressing 431. Replacing of 41 is thus a means of reversing this process, by sliding in a new 41 into 40, changing from B4 to B3 and compressing 431; lifting 44 while maintain 41's position such that 440 and 412 are realigned to

change from B3 to B2; before releasing 41 and allow the natural extension of 431 to push 41 forward, connecting 412 and 440 to change from B2 to B1.

In the case of 31, an extra jaw adjustment option is found via 311, as seen in FIG. 8A and 8B, to aid in fine tuning the jaw width to accommodate the different tube diameters 31 will be used on. The internal end of 311 limits the maximum displacement of 41 being clamped down. As such, adjusting 311 inwards into 40 causes 41 to be moved further away from 42, accommodating larger tube diameters. Conversely, adjusting 311 outwards of 40 causes 41 to be moved closer to 42, accommodating smaller tube diameters.

For ease of use of 20, there are multiple configurations that can be applied. For users constantly on the move, 20 may be carried around in hand or placed in a form of pouch 24 to form carrying configuration C for a more hands free experience when using the device. This thus improves ease of use in such scenarios where users need to be on the move to seal multiple tubes at different locations. However in using 20 on the go, 24 has the additional benefit of freeing both of the user's hands to hold the tube and seal it with 21, thereby ensuring a better job done.

A linkable charging dock 25 can also be applied to 20 to form charging configuration E as seen in FIG. 10A to 10C. This provides users with the option of a desktop setup, whereby power can be constantly supplied to the device 20 via input power port 53 linked to charging point 252 that charges 22. This setup provides a hands free experience as well, with users simply putting the tube into the exposed jaw of 21 and allow their hands to simultaneously activate the hand activated mechanism 50 on its side, thereby activating the triggering mechanism 251 to depress 44 and cause 21 to seal the tube. As seen from FIG. 10D this can be a modular setup as well, with user's free to link additional 25 side by side such that multiple sealing can be performed at one time with each segment done being of consistent size. The female port 51 and male port 52 on each side of 25 enable communication between the multiple 25 units.

An alternative modular multi-sealing set up can be found in a tower variation of 20, dubbed linkable tower RF tube sealer 26 as seen in FIG. 11A and 11B. This variation compresses the functionality of 20 and 25 into a single unit, retaining the same functionality as 25 with activation of 40 via 50 and being powered via 53, but with a smaller spatial footprint due to a more compact design. From FIG. 11C, the same modular multilink set up can be done with multiple 26 units connected side by side via 51 and 52 and communicated through them, allowing multiple sealing to be performed on a single tube simultaneously with consistent size.

CLAIMS

These invented compact tube sealers 10 claims that:

1. The compact tube sealers 10 can come in the form of a portable RF tube sealer 20 and a compact thermal tube sealer 30.
2. The portable RF tube sealer 20 is used for tubes that have dielectric properties.
3. The compact thermal tube sealer 30 is used for tubes made of thermoplastic elastomer.
4. The portable RF tube sealer 20 comprises of a RF hand gun 21, portable RF control unit 22, and a detachable power cord 23.
5. The RF hand gun 21 comprises of a hand gun enclosure 210 and an internal clamping mechanism 40.
6. The portable RF control unit 22 comprises of a unit enclosure 220, a battery pack 221, a control circuit 222, a power button with indicator lights 223, a power connector port 224, a power supply input port 225.
7. The design of 21 is ergonomically designed for females, who are the majority operating the tube sealers.
8. The relatively small profile of the portable RF control unit 22 as well as its battery pack 221 enables the portable RF tube sealer 20 to be used at multiple locations without the need for a local power source.
9. The compact thermal tube sealer 30 comprises of a thermal hand gun 31, compact thermal control unit 32, and a detachable power cords 33.
10. The thermal hand gun 31 comprises of a hand gun enclosure 310, an internal clamping mechanism 40, and an adjustment dial 311.
11. The compact thermal controller unit 32 comprises of a controller unit enclosure 320, a power button 321, a temperature and timer controller circuit board 322, a temperature and timer adjuster knobs 323, a display panel 324, and a buzzer 325.
12. The compact design of 32 enables it to take up less table space when in use compared to traditional devices
13. The temperature and timer adjuster knobs 323 and display panel 324 enables users to perform fine adjustments of the thermal sealer's settings when used on different types of tubes.
14. The buzzer 325 provides safety measures when using the compact thermal tube sealer 30 by alerting users when the sealing process is complete.
15. The internal clamping mechanism 40 caters for both the portable RF tube sealer 20 and the

compact thermal tube sealer 30.

16. The internal clamping mechanism 40 consists of a moving jaw 41, fixed jaw 42, mechanism base 43, trigger handle 44, and jaw enclosure 45.
17. The moving jaw 41 has a scoring feature 411 and pin hook 412.
18. The internal clamping mechanism 40 of claim (15) utilizes hardened metal on the moving jaw 41 and fixed jaw 42 to minimize wear and tear.
19. The design of the moving jaw 41 and fixed jaw 42 optimizes the sealing properties of the jaws while preventing the denaturing of the medium in the tube during the sealing process.
20. The scoring feature 411 of claim (17) produces a scoring line on the tube after sealing to provide easy separation of the sealed tube segments.
21. The mechanism base 43 consists of a spring 431, dowel rod 432, and limit switch 433.
22. The internal clamping mechanism 40 clamps tubes through use of a system comprising of moving jaw 41, pin hook 412, fixed jaw 42, spring 431, dowel rod 432, limit switch 433, trigger handle 44, and moving jaw pin 440.
23. The internal clamping mechanism 40 enables easy interchangeability of the moving jaw 41 via a push and drop method.
24. The push and drop method of claim (23) enables worn out moving jaw 41 due to wear and tear from repeated usage to be easily replaced.
25. The push and drop method enables different size variations of moving jaw 41 to be easily interchanged to accommodate sealing of tubes with different diameters.
26. The push and drop method) utilizes the pin hook 412, moving jaw pin 440, spring 431, and trigger handle 44 to lock and unlock the moving jaw 41.
27. The internal clamping mechanism 40 has 4 configurations in performing the push and drop method: a rest configuration B1, pushed configuration B2, dropped configuration B3, and released configuration B4.
28. The push and drop method is used in the sequence going from initial rest configuration B1, to pushed configuration B2, to dropped configuration B3, and to released configuration B4 to remove a moving jaw 41.
29. The push and drop method can be used in the reversed order from claim (28) to reinsert a new/different size moving jaw 41.
30. The adjustment dial 311 of claim (10) enables fine tuning of the width of the internal clamping mechanism 40 in the thermal hand gun 31.
31. The portable RF tube sealer 20 can be carried around by hand.
32. The portable RF tube sealer 20 can be carried around with use of a form of pouch 24.

33. Use of a form of pouch 24 frees both of the user's hands to seal the tubes effectively.
34. A linkable charging dock 25 can used in conjunction with the portable RF tube sealer 20 to form a modular desktop set-up.
35. The linkable charging dock 25 features a hand activated mechanism 50, female port 51, male port 52, input power port 53, triggering mechanism 251, and charging point 252.
36. The linkable charging dock 25 is able to charge the portable RF control unit 22 and hold the RF hand gun 21 with exposed internal clamping mechanism 40.
37. The portable RF tube sealer 20 can be activated when placed on linkable charging dock 25 via hand activated mechanism 50 when a tube is inserted into internal clamping mechanism 40.
38. Additional linkable charging dock 25 can be connected to via female port 51 and male port 52 to perform multiple sealing on a tube simultaneously.
39. The female port 51 and male port 52 provide communication between linkable charging docks 25 to perform the multiple seals of claim (39).
40. Tube segments sealed by the modular linkable charging dock 25 can be of a consistent size based on the positioning of each linkable charging dock 25.
41. A linkable tower RF tube sealer 26 can be used as an alternative modular multi-sealing set up.
42. The linkable tower RF tube sealer 26 can be activated via hand activated mechanism 50 when a tube is inserted into internal clamping mechanism 40.
43. Additional linkable tower RF tube sealer 26 can be connected to via female port 51 and male port 52 to perform multiple sealing on a tube simultaneously.
44. The female port 51 and male port 52 provide communication between linkable tower RF tube sealers 26 to perform the multiple seals of claim (43).
45. Tube segments sealed by the multiple linkable tower RF tube sealer 26 can be of a consistent size based on the positioning of each linkable tower RF tube sealer 26.