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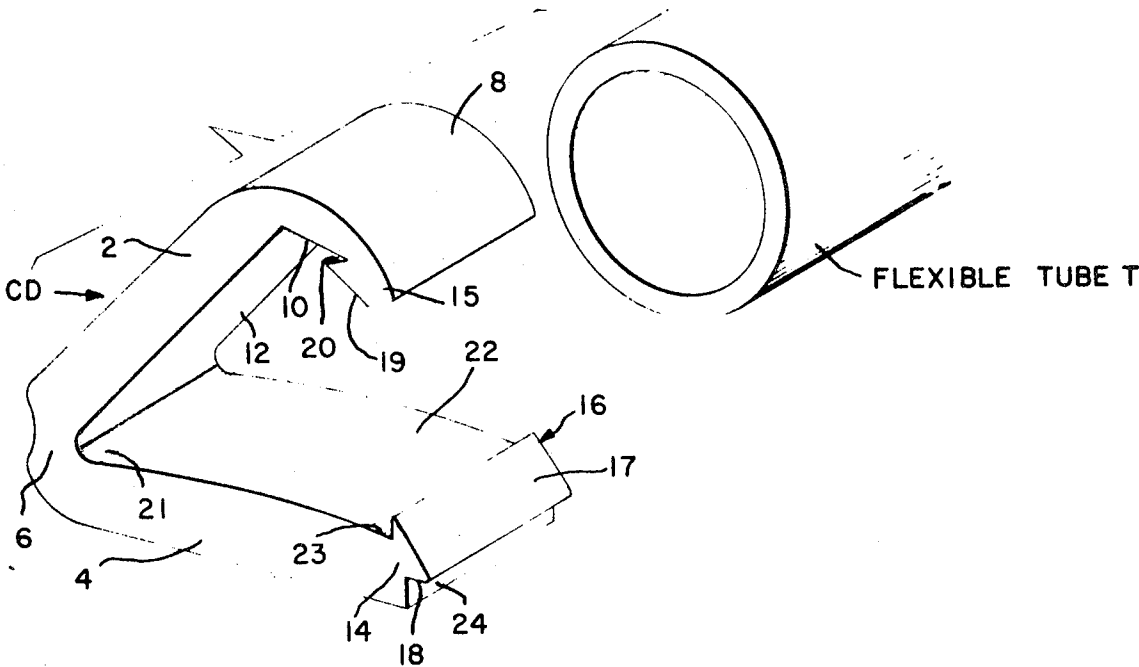
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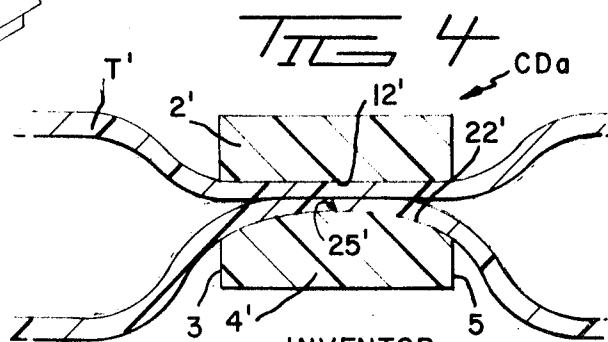
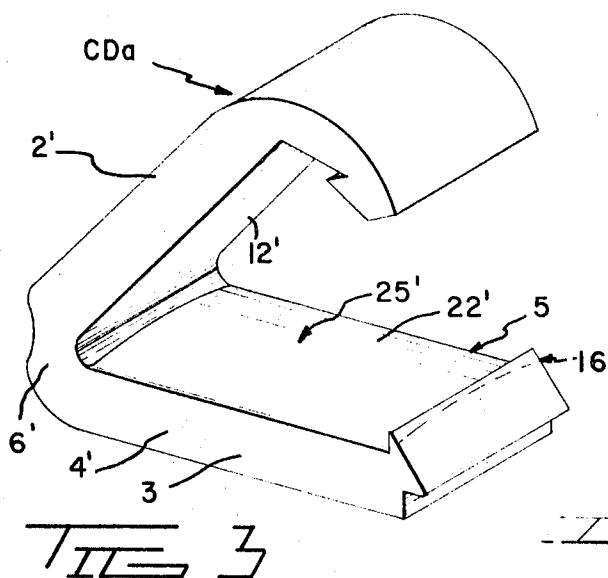
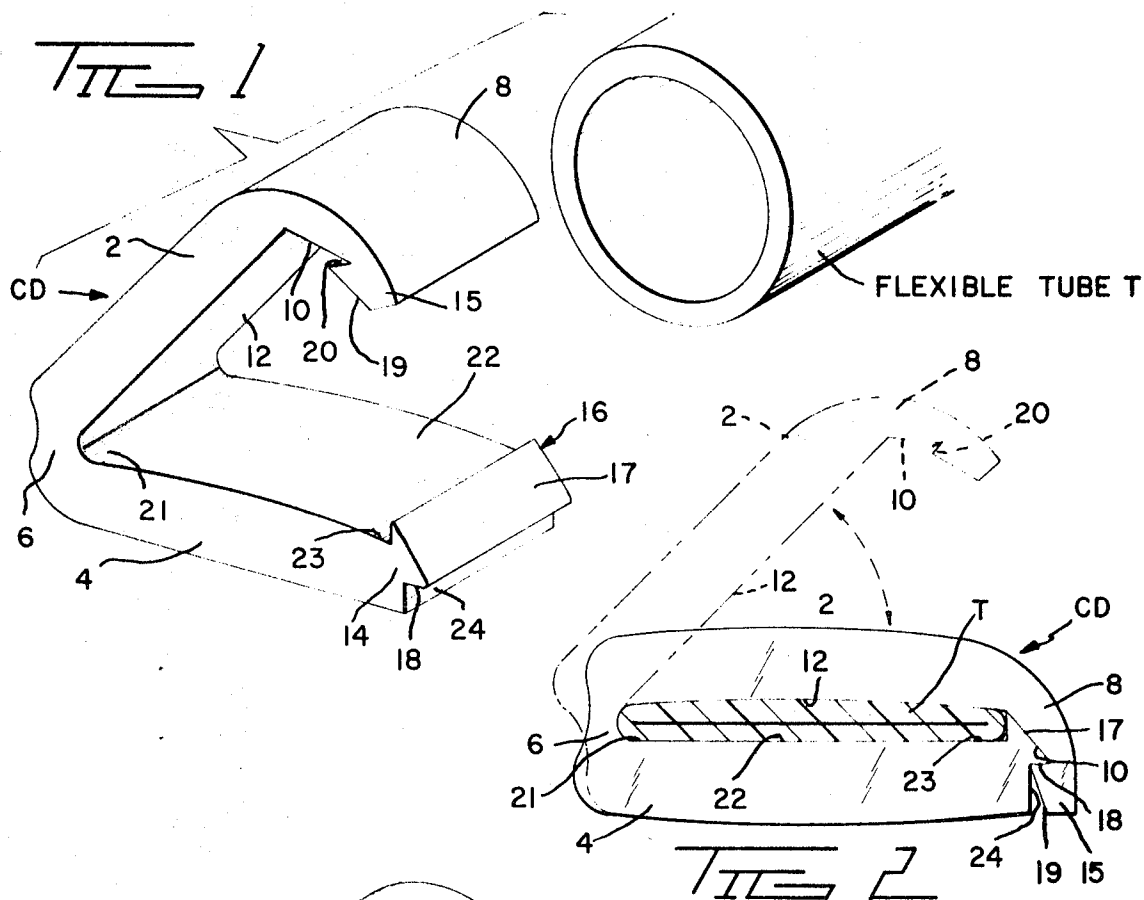
[54] **FLEXIBLE TUBE CLOSURE**
1 Claim, 8 Drawing Figs.

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24/23 W, 24/255 SL, 251/9
[51] Int. Cl..... **F16k 7/04**
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10; 128/346; 24/129.2, 255 SL, 248 BB

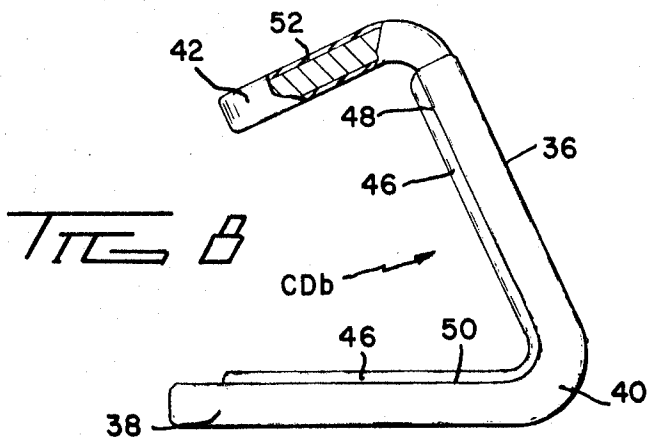
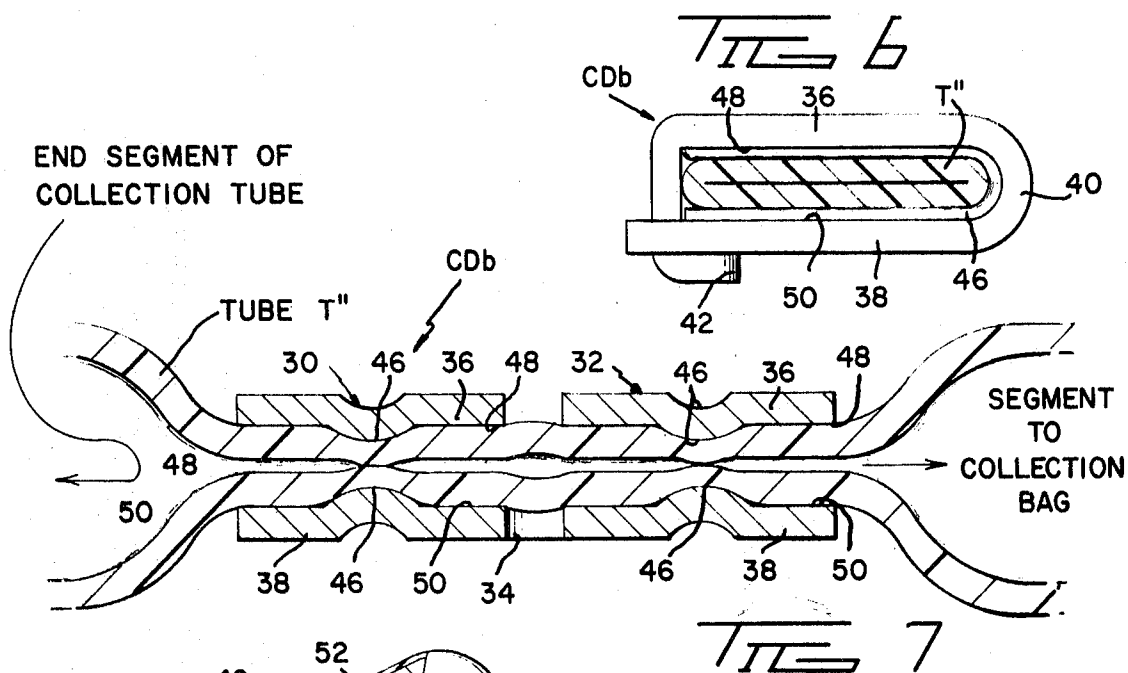
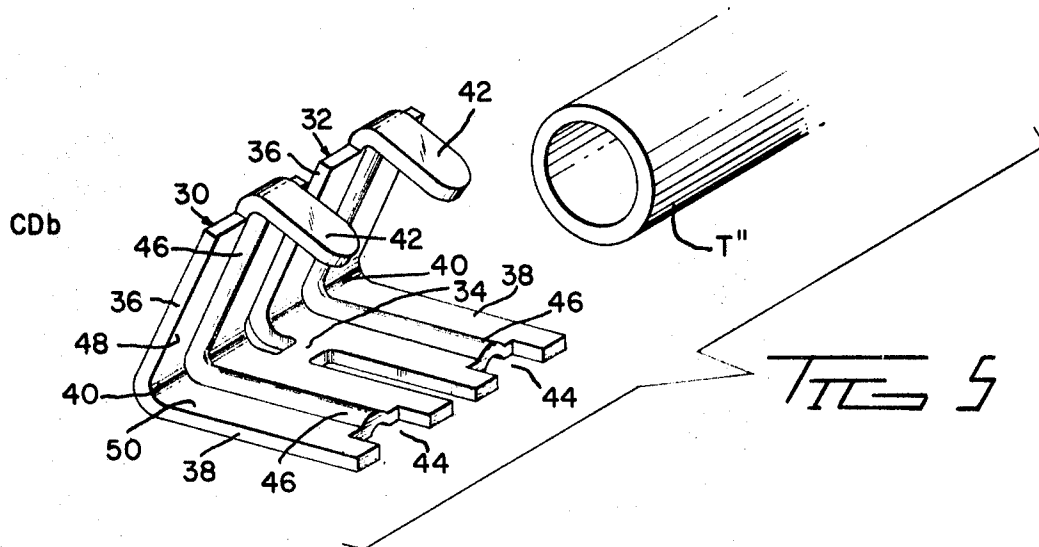
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ABSTRACT: Tube closure devices comprising bendable members, each having a pair of arms connected together by integral hinges are disclosed. Coacting latch arrangements are disposed on the extending ends of the arms to latch the arms over sections of flexible tubes which are placed under compression via the closure devices. Raised floor sections on at least one of the arms serve to compress and sealingly close the tube such that residual pressures are provided in a closure. Alternate curved floor sections also assure a sealed closure and provide strain relief means in a closure where the flexible tubes join closure devices.





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FLEXIBLE TUBE CLOSURE

This invention relates to closure devices of the type used to sealingly close flexible tubes.

In blood donating operations, flexible bags are generally used to collect and store human blood. Flexible tubes extending from the bags are used for a twofold purpose: First, they convey blood from the donor to the collection bag; secondly, they are used to house small samples of blood. Immediately after a donation, the technician closes the tube at intermittent sections along the length thereof. The sections may be individually removed at a later time so that the samples therein may be tested.

It is imperative that the ends of the tube be hermetically sealed so that the blood in the collection bag does not become contaminated.

Most prior tube closure devices are in the form of an intricate clip or clamp which is usually deformed when secured around a tube. This usually requires a special tool to deform the device onto the tube. Other tube closure means include an intricate welding or heat-sealing apparatus.

It is an object of this invention to provide closure devices for flexible tubes which are simple in construction, which are quick and easy to use, and which are made from nylon or other suitable plastic.

Another object is the provision of closure devices for flexible tubes which are simple in construction which are quick and easy to use, and which are made of bendable metal such as aluminum.

An additional object is to provide closure devices which will hermetically seal flexible tubes without the aid of intricate application tooling.

A further object is to provide a closure device which may be reopened and reused.

Still another object is the provision of closure devices of the type described which, due to their unique simplicity of design, can be manufactured inexpensively, and therefore they can be marketed as inexpensive items.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention but are given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

FIG. 1 is a perspective view of a closure device in an open position in accordance with the invention;

FIG. 2 is a side elevational view of a tube closure device in a closed position on a flexible tube and showing the tube in cross section;

FIG. 3 is a perspective view of an alternative embodiment in an open position;

FIG. 4 is a cross-sectional view taken transversely through a tube closure of FIG. 3 in a closed position on a flexible tube;

FIG. 5 is a perspective view of still another embodiment in an open position;

FIG. 6 is a side elevational view of the closure device of FIG. 5 closed onto a flexible tube;

FIG. 7 is a cross-sectional view taken longitudinally through a pair of closure devices of FIG. 5 showing a flexible tube compressed; and

FIG. 8 is a side elevational view of a further embodiment in an open position.

Referring to FIG. 1, a closure device CD comprises a pair of arms 2 and 4 secured together at one end by a hinge portion 6 to define a one-piece closure device which is molded from a suitable plastic material in accordance with conventional molding techniques. The extending end portion 8 of arm 2 is curved inwardly with a hook shape towards the device and is

provided with a bevelled recess 10. The inside surface 12 of arm 2 is flat along the length of the arm from hinge 6 to recess 10. The extending end portion 14 of arm 4 terminates in a triangular-shaped projection 16 having a ledge portion 18 thereon. The recess 10 of arm 2 cooperates with sloped surface 17 of projection 16 when the arms are closed such that ledge 18 snappingly receives ledge 20 to latch the arms together. The floor 22 of arm 4 is transversally arcuate from hinge 6 to triangular-shaped projection 16, so that floor 22 is arcuate in a direction normal with respect to the axis of the closure device. End 15 is provided with tapered surface 19 and surface 17 acts to cam end 15 out far enough via engagement of surface 19 therewith so that ledge 20 can be latchably mated with ledge 18.

In use, referring to FIGS. 1 and 2, a device CD is disposed over a flexible tube T whereafter the device is closed to sandwich the tube between arms 2 and 4. During closing, the tube becomes compressed between arcuate floor 22 and flat surface 12. At final closing of the device, ledge 20 of arm 2 snaps into place and engages ledge 18 on arm 4 to latch the arms together. Also at final closing, the extreme ends 21 and 23 of arcuate floor 22 are pulled upwardly, thus tending to straighten floor 22. This arrangement provides residual forces in the device, which continually compress tube T to insure a sealed closure. Tapered surface 19 of end 15 is spaced from straight surface 24 to enable gripping end 15 or placing a tool between surfaces 15 and 24 to unlatch arms 2 and 4 from each other.

Referring to FIG. 3 and 4, another closure device CDa comprises a pair of arms 2' and 4' which are secured together at one end by an integral hinge 6'. This closure device and its latching arrangement to latch the arms together are identical to the device of FIGS. 1 and 2 with the exception of floor 22'. Floor 22', from hinge 6' to projection 16', is arcuately curved from one side 3 of arm 4' to the other side 5 of arm 4' as illustrated in FIG. 4 to provide a convex surface. The curve is disposed so that its highest portion 25' is directly along the center of floor 22' from hinge 6' to projection 16'.

In use, referring to FIGS. 3 and 4, a closure device CDa is disposed over a flexible tube T', whereafter the device is closed to sandwich the tube between arms 2' and 4'. During closing, the tube T' becomes compressed between arcuate floor 22' and flat surface 12'. At final closing, the latching arrangement, as described above, latches the arms 2' and 4' together. In this embodiment, the highest portion 25' of arcuate floor 22' compresses tube T' tightly in the center across a closure device, FIG. 4. Tube T' becomes sealed in the closure device by virtue of high compression forces in the center of the device. The tube T' blends gradually outwardly from the device by virtue of curved floor 22' to define a strain relief for tube T'.

It should be noted that the above devices have latch arrangements which may be opened, if desired. To open, ledge 20 in arm 2 is removed from ledge 18 in arm 4 to allow arm 2 to spring back to its original open position. In the embodiment of FIGS. 3 and 4, the latch arrangement, which is identical to that of FIGS. 1 and 2, is removed as described above.

It should also be noted that other irregular surfaces such as grooves, ridges, bumps or serrations may be provided on the inner surfaces of one or both arms, if desired.

Referring to FIG. 5, another closure device CDb comprises a pair of V-shaped closure members 30 and 32 which are identical in shape and which are formed from bendable metal, such as, for example, aluminum. Members 30 and 32 are fabricated from flat sheet stock, and they are joined by an integral strap 34 to provide a one-piece closure device. Each member has a pair of arms 36 and 38 which are connected by respective bights 40 acting as hinges. The extending ends of arms 36 terminate in tabs 42 which are identical for each member and which are reduced in width from the width of arms 36 so as to be centrally disposed relative thereto. Tabs 42 are bent to a hook shape so as to be directed inwardly towards arms 38. The ends of arms 38 have recesses 44 defining slots

to receive tabs 42. Inwardly directed ridges or ribs 46 are formed in members 30 and 32 so as to be disposed on the flat surfaces 48 of arms 36, along hinges 40 and on floor surfaces 50 of arms 38. The ribs may be disposed only in the members 30 and 32 and offset relative to one another or only one of members 30 and 32 may be provided with a rib.

In use, as illustrated in FIGS. 5, 6 and 7, a double closure device 30 and 32 is disposed over a flexible tube T'' whereafter the device is closed to sandwich the tube between arms 36 and 38. During closing, the tube T'' becomes generally compressed between surfaces 48 and 50 of the arms, and it is tightly compressed between ridges 46, see FIG. 7. When the devices 30 and 32 are fully closed, tabs 42 are disposed in respective recesses 44, and they are bent inwardly along arms 38, see FIG. 6. This arrangement latches the devices onto a tube and prevents them from being accidentally removed. The devices may be removed, if desired, by bending tabs 42 out of their respective recesses 44 and opening the arms 36 and 38. The closure devices may be closed onto a tube by a simple handtool such as pliers, or they may be disposed in a simple applicator of the staple type (not shown).

Referring particularly to FIG. 7, if at some later time a sample of blood is to be checked, the end test segment of a collection tube is removed by severing a closure device along the broken line through strap 34. After severing, the end segment of the collection tube remains closed and sealed by closure device 30, and the next segment (now the end segment) remains closed and sealed by closure device 32. The segment removal procedure may be continued from time-to-time until all test segments are removed.

Referring now to FIG. 8, the closure devices 30 and 32 may be coated with plastic material 52 in accordance with conventional plastic-coating techniques such as, for example, dipping, spraying or fluidized bed. The plastic coating will not only eliminate sharp edges on the closure device proper which may snag a tube, but it will add to the sealing characteristics of a closure device.

It should be noted that closure devices according to this invention may be used on plastic tubes other than those of blood collection apparatus. The devices may also be used on other

flexible tubes such as elastomeric material. The devices not only provide a liquid seal, but they also provide an airtight seal.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiments of the invention, which are shown and described herein, are intended as merely illustrative and not as restrictive of the invention.

The invention is claimed in accordance with the following:

1. In a closure device of unitary resilient construction having first and second arms integral with and diverging from a hinge, together with latching structure for latching together said arms, the improvements comprising:

a depending hook-shaped end portion on said first arm and provided with a first ledge portion in spaced relationship from and spanning the transverse dimension of said first arm and defining an adjacent recess extending the entire transverse dimension of said first arm,

said second arm having an inner surface including an arcuate convex portion extending the entire transverse dimension of said second arm,

said second arm having a projecting end portion projecting above the inner surface of said second arm,

said projecting end portion having a triangular-shaped projection with one side of said triangular-shaped projection being exposed along a planar surface and forming an elongated planar sloped surface,

another side of said triangular portion defining a second ledge portion,

said projecting end portion being substantially entirely received in said recess of said first arm and substantially tightly fitting with said recess, with said ledge portions engaging each other thereby latching together said arms, and

said second arm having the ends thereof pulled upwardly from a straightened configuration of said second arm and providing residual forces tending to return said second arm to said straightened configuration.

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