

NEEDLE SHIELD REMOVERS, DRUG DELIVERY DEVICES, AND RELATED METHODS

[0001] Priority is claimed to US Provisional Patent Application No. 62/960,463, filed January 13, 2020, and the entire contents thereof are hereby incorporated herein by reference.

Field of the Disclosure

[0002] The present disclosure relates to drug delivery devices, and, more particularly, devices for automatically injecting a drug into a patient.

Background

[0003] A general aversion to exposed needles, as well as health and safety issues, have led to the development of drug delivery devices which conceal a needle or other insertion member prior to use and which automate various aspects of an injection process. Such devices offer a variety of benefits as compared with traditional forms of drug delivery including, for example, delivery via a conventional syringe.

[0004] A drug delivery device may incorporate various mechanisms to implement various automated features. Such features include automatically covering a needle in a pre-delivery and/or post-delivery state, providing an interface for a user to activate a drive mechanism, indicating to the user that drug delivery is complete, among other features. Typically a drug delivery device will incorporate a separate or independently operable mechanism to realize each of its automated features. As a consequence, with each added feature, the mechanical complexity of the device tends to increase. This, in turn, can increase the size of the device, which can make it cumbersome for the user to handle, as well as increase manufacturing costs and timeframes. As the demand grows for drug delivery devices with greater ease of use and safety, finding a way to incorporate more automated features without adding undue complexity to the drug delivery device presents various design and manufacturing challenges.

[0005] The present disclosure sets forth drug delivery devices embodying advantageous alternatives to existing drug delivery devices, and that may address one or more of the challenges or needs mentioned herein.

Summary

[0006] In accordance with a first aspect, there is provided a needle shield remover ~~is described that includes comprising:~~ a body having a tubular configuration with first and second ends, ~~where~~ the body ~~is~~ formed from a sheet of material having opposing first and second longitudinal edges. ~~The needle shield remover further includes;~~ and a closure configured to couple the first and second longitudinal edges together to form the tubular configuration of the body. ~~The closure includes comprising:~~ a plurality of teeth extending laterally outwardly from the first longitudinal edge, and a plurality of grooves extending laterally inwardly into the sheet of material from the second longitudinal edge, wherein the plurality of teeth extend generally perpendicularly away from the first longitudinal edge; and the plurality of grooves extend along an axis at an angle with respect to the second longitudinal edge, such that the plurality of teeth bend as each respective tooth enters a respective one of the plurality of grooves.

[0007] In some forms, the needle shield remover can include a first plurality of barbs arrayed around a circumference of the body adjacent to the first end and a second plurality of barbs arrayed around a circumference of the body adjacent to the second end. In further forms, each of the first plurality of barbs and the second plurality of barbs can extend within an opening of the body and include a distal end having laterally spaced pointed tips and/or the first plurality of barbs and the second plurality of barbs can extend inwardly into the body.

[0008] ~~In some forms, the plurality of teeth can extend generally perpendicularly away from the first longitudinal edge; and the plurality of grooves can extend along axis at an angle with respect to the second longitudinal edge, such that the plurality of teeth bend as each respective tooth enters a respective one of the plurality of grooves.~~ In further forms, each of the plurality of teeth can include an associated cut-out portion configured to relieve stress within the material as a result of the plurality of teeth bending. In some examples, the cut-out portion can be disposed in an edge of each of the plurality of teeth or in a corner

between each of the plurality of teeth and the first longitudinal edge. In additional forms, the plurality of grooves can extend along an axis at an angle of between 5 degrees and 20 degrees with respect to the second longitudinal edge and/or the axes of the

plurality of grooves can be staggered to extend above or below a horizontal line extending between the first and second longitudinal edges.

[0009] In accordance with a second aspect, there is provided an auto-injector drug delivery device ~~is described that includes comprising:~~ a housing; a drug container coupled to the housing, ~~where~~ the drug container includes ~~ing~~ a needle; a needle shield disposed at least partially over a distal end of the needle of the drug container; ~~and~~ a removable cap coupled to the housing; ~~and~~ ~~. The auto-injector drug delivery device further includes~~ a needle shield remover defined in the first aspect that is coupled to the removable cap and the needle shield, such that uncoupling the removable cap from the housing removes the needle shield off the needle of the drug container. ~~The needle shield remover includes a body having a tubular configuration with first and second ends, the body formed from a sheet of material having opposing first and second longitudinal edges and a closure coupling the first and second longitudinal edges together to form the tubular configuration of the body. The closure includes a plurality of teeth that extend laterally outwardly from the first longitudinal edge and a plurality of grooves that extend laterally inwardly into the sheet of material from the second longitudinal edge, where the plurality of grooves receive the plurality of teeth to couple the first and second longitudinal edges together.~~

[0010] In some forms, the needle shield remover can include a first plurality of barbs arrayed around a circumference of the body adjacent to the first end and a second plurality of barbs arrayed around a circumference of the body adjacent to the second end, where the first plurality of barbs grip the removable cap and the second plurality of barbs grip the needle shield. In further forms, each of the first plurality of barbs and the second plurality of barbs can extend within an opening of the body and include a distal end having laterally spaced pointed tips and/or the first plurality of barbs and the second plurality of barbs can extend inwardly into the body.

[0011] In some forms, the removable cap can include a central wall configured to be gripped by the first plurality of barbs and, in further forms, an annular wall spaced outwardly from the central wall configured to engage an outer surface of the first end of the body.

[0012] The closure of these forms can have a configuration according to any of the above configurations. Additionally, the needle shield remover of any of the above forms can be symmetrical about a horizontal plane extending through a midpoint of the body perpendicular to a longitudinal axis thereof.

[0013] In accordance with a third aspect, there is provided a method of forming ~~a~~the needle shield remover as defined in the first aspect from a strip of metal ~~is described that, the method comprising: includes~~ forming a sheet from the strip of metal having first and second longitudinal edges and end edges, where the sheet ~~includes a~~comprising the closure for the needle shield remover including ~~a~~the plurality of teeth extending laterally outwardly from the first longitudinal edge and ~~a~~the plurality of grooves extending laterally inwardly into the sheet of material from the second longitudinal edge. ~~The method further includes;~~ forming a first plurality of barbs across a width of the strip of metal; forming a second plurality of barbs across the width of the strip of metal; and creating a tubular form from the sheet by forcing the plurality of teeth into the plurality of grooves.

[0014] ~~In some forms, the plurality of teeth can extend generally perpendicularly away from the first longitudinal edge, the plurality of grooves can extend along axis at an angle with respect to the second longitudinal edge, and the method can include creating the tubular form from the sheet comprises bending the plurality of teeth as each respective tooth enters a respective one of the plurality of grooves.~~

[0015] In some forms, the method can include punching guide holes into the trip of metal to form a cutting pattern for the closure, the first plurality of barbs, and the second plurality of barbs.

Brief Description of the Drawings

[0016] Figure 1 is a perspective view of a drug delivery device according to various embodiments of the present disclosure.

[0017] Figure 2 is cross-sectional view of the drug delivery device in Figure 1.

What is Claimed is:

1. A needle shield remover comprising:

a body having a tubular configuration with first and second ends, the body formed from a sheet of material having opposing first and second longitudinal edges; and

a closure configured to couple the first and second longitudinal edges together to form the tubular configuration of the body, the closure comprising:

a plurality of teeth extending laterally outwardly from the first longitudinal edge; and

a plurality of grooves extending laterally inwardly into the sheet of material from the second longitudinal edge,

wherein the plurality of teeth extend generally perpendicularly away from the first longitudinal edge; and the plurality of grooves extend along an axis at an angle with respect to the second longitudinal edge, such that the plurality of teeth bend as each respective tooth enters a respective one of the plurality of grooves.

~~2. The needle shield remover of claim 1, wherein the plurality of teeth extend generally perpendicularly away from the first longitudinal edge; and the plurality of grooves extend along axis at an angle with respect to the second longitudinal edge, such that the plurality of teeth bend as each respective tooth enters a respective one of the plurality of grooves.~~

~~32. The needle shield remover of claim 21, wherein each of the plurality of teeth include an associated cut-out portion configured to relieve stress within the material as a result of the plurality of teeth bending.~~

~~43. The needle shield remover of claim 32, wherein the cut-out portion is disposed in an edge of each of the plurality of teeth or in a corner between each of the plurality of teeth and the first longitudinal edge.~~

~~54. The needle shield remover of any one of the preceding claims 2 to 4, wherein the plurality of grooves extend along the axis at an angle of between 5 degrees and 20 degrees with respect to the second longitudinal edge.~~

~~65. The needle shield remover of any one of the preceding claims 2 to 5, wherein the axes of the plurality of grooves are staggered to extend above or below a horizontal line extending between the first and second longitudinal edges.~~

~~76. The needle shield remover of any one of the preceding claims, further comprising:
a first plurality of barbs arrayed around a circumference of the body adjacent to the first end; and
a second plurality of barbs arrayed around a circumference of the body adjacent to the second end;
wherein each of the first plurality of barbs and the second plurality of barbs comprise a member extending within an opening of the body, a distal end of the member having laterally spaced pointed tips.~~

~~87. The needle shield remover of any one of the preceding claims, further comprising:
a first plurality of barbs arrayed around a circumference of the body adjacent to the first end; and
a second plurality of barbs arrayed around a circumference of the body adjacent to the second end;
wherein the first plurality of barbs and the second plurality of barbs extend inwardly into the body.~~

~~98. The needle shield remover of any one of the preceding claims, wherein the needle shield remover is symmetrical about a horizontal plane extending through a midpoint of the body perpendicular to a longitudinal axis thereof.~~

~~109~~. An auto-injector drug delivery device comprising:

a housing;

a drug container coupled to the housing, the drug container including a needle;

a needle shield disposed at least partially over a distal end of the needle of the drug container;

a removable cap coupled to the housing; and

~~a~~the needle shield remover ~~of claim 1~~ coupled to the removable cap and the needle shield, such that uncoupling the removable cap from the housing removes the needle shield off the needle of the drug container, ~~the needle shield remover comprising:~~

~~a body having a tubular configuration with first and second ends, the body formed from a sheet of material having opposing first and second longitudinal edges;~~

~~and~~

~~a closure coupling the first and second longitudinal edges together to form the tubular configuration of the body, the closure comprising:~~

~~a plurality of teeth extending laterally outwardly from the first longitudinal edge; and~~

~~a plurality of grooves extending laterally inwardly into the sheet of material from the second longitudinal edge, the plurality of grooves receiving the plurality of teeth to couple the first and second longitudinal edges together.~~

~~11. The autoinjector drug delivery device of claim 10, wherein the plurality of teeth extend generally perpendicularly away from the first longitudinal edge; and the plurality of grooves extend along axis at an angle with respect to the second longitudinal edge, such that the plurality of teeth bend as each respective tab enters a respective one of the plurality of grooves.~~

~~12~~10. The autoinjector drug delivery device of claim ~~11~~49, wherein the axes of the plurality of grooves are staggered to extend above or below a horizontal line extending between the first and second longitudinal edges.

~~13~~11. The autoinjector drug delivery device of ~~claim 9 or claim 10~~any one of claims 10 to 12, wherein the needle shield remover further comprises:

a first plurality of barbs arrayed around a circumference of the body adjacent to the first end, the first plurality of barbs gripping the removable cap;

a second plurality of barbs arrayed around a circumference of the body adjacent to the second end, the second plurality of barbs gripping the needle shield;

~~14~~12. The autoinjector drug delivery device of claim ~~13~~11, wherein each of the first plurality of barbs and the second plurality of barbs extend within an opening of the body and include a distal end having laterally spaced pointed tips.

~~15~~13. The autoinjector drug delivery device of claim ~~13~~11 or ~~14~~12, wherein the first plurality of barbs and the second plurality of barbs extend inwardly into the body.

~~16~~14. The autoinjector drug delivery device of claim ~~15~~13, wherein the removable cap comprises a central wall configured to be gripped by the first plurality of barbs and an annular wall spaced outwardly from the central wall configured to engage an outer surface of the first end of the body.

~~47~~15. The autoinjector drug delivery device of any one of claims ~~109~~ to ~~46~~14, wherein the needle shield remover is symmetrical about a horizontal plane extending through a midpoint of the body perpendicular to a longitudinal axis thereof.

~~48~~16. A method of forming ~~a~~the needle shield remover ~~of claim 1~~ from a strip of metal, the method comprising:
forming a sheet from the strip of metal having first and second longitudinal edges and end edges, the sheet comprising ~~a~~the closure for the needle shield remover including ~~a~~the plurality of teeth extending laterally outwardly from the first longitudinal edge and ~~a~~the plurality of grooves extending laterally inwardly into the sheet of material from the second longitudinal edge;

forming a first plurality of barbs across a width of the strip of metal;

forming a second plurality of barbs across the width of the strip of metal; and

creating a tubular form from the sheet by forcing the plurality of teeth into the plurality of grooves.

~~19. The method of claim 18, wherein the plurality of teeth extend generally perpendicularly away from the first longitudinal edge; the plurality of grooves extend along axis at an angle with respect to the second longitudinal edge; and creating the tubular form from the sheet comprises bending the plurality of teeth as each respective tooth enters a respective one of the plurality of grooves.~~

~~20~~17. The method of claim ~~48~~16 ~~or 19~~, further comprising punching guide holes into the trip of metal to form a cutting pattern for the closure, the first plurality of barbs, and the second plurality of barbs.