US 20110306933A1

(19) **United States**

(12) **Patent Application Publication**

Djordjevic et al.

(10) **Pub. No.: US 2011/0306933 A1**

(43) **Pub. Date: Dec. 15, 2011**

(54) **SAFETY CANNULA WITH AUTOMATIC RETRACTABLE NEEDLE**

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(21) Appl. No.: **12/802,676**

(22) Filed: **Jun. 11, 2010**

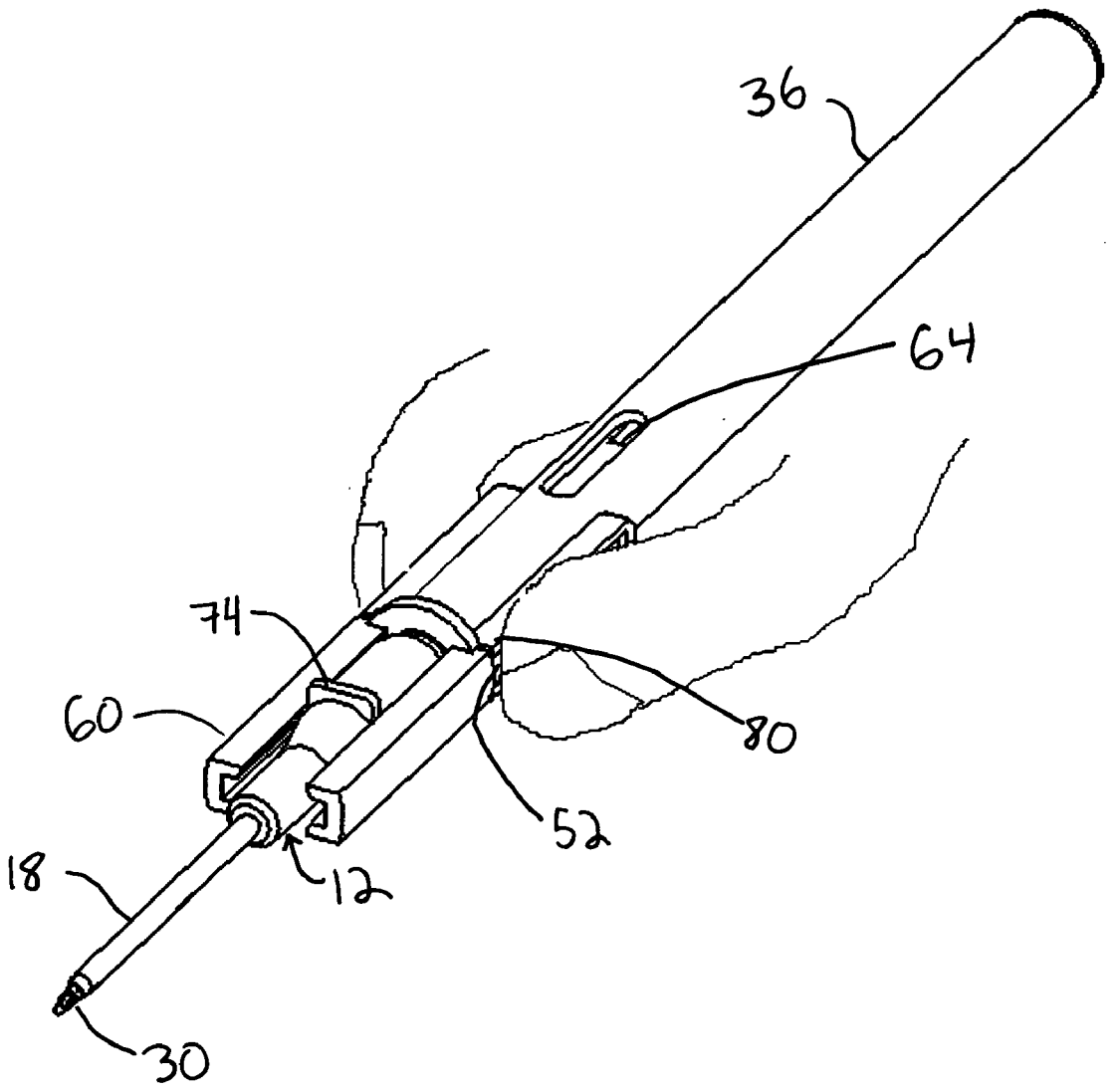
Publication Classification

(51) **Int. Cl.**
A61B 17/34 (2006.01)

(52) **U.S. Cl.** **604/164.08**

(57) **ABSTRACT**

An intravenous cannula device (**10**) having a cannula body (**12**), a needle carrier (**20**), and a needle carrier container (**36**) nested in series. The needle carrier is spring loaded (**48**) toward the container, and the container carries an external lever assembly (**50**) that triggers the spring as the cannula is pushed forward of the container toward full insertion in the patient, whereby the released spring drives the needle carrier including needle (**30**) into the container.



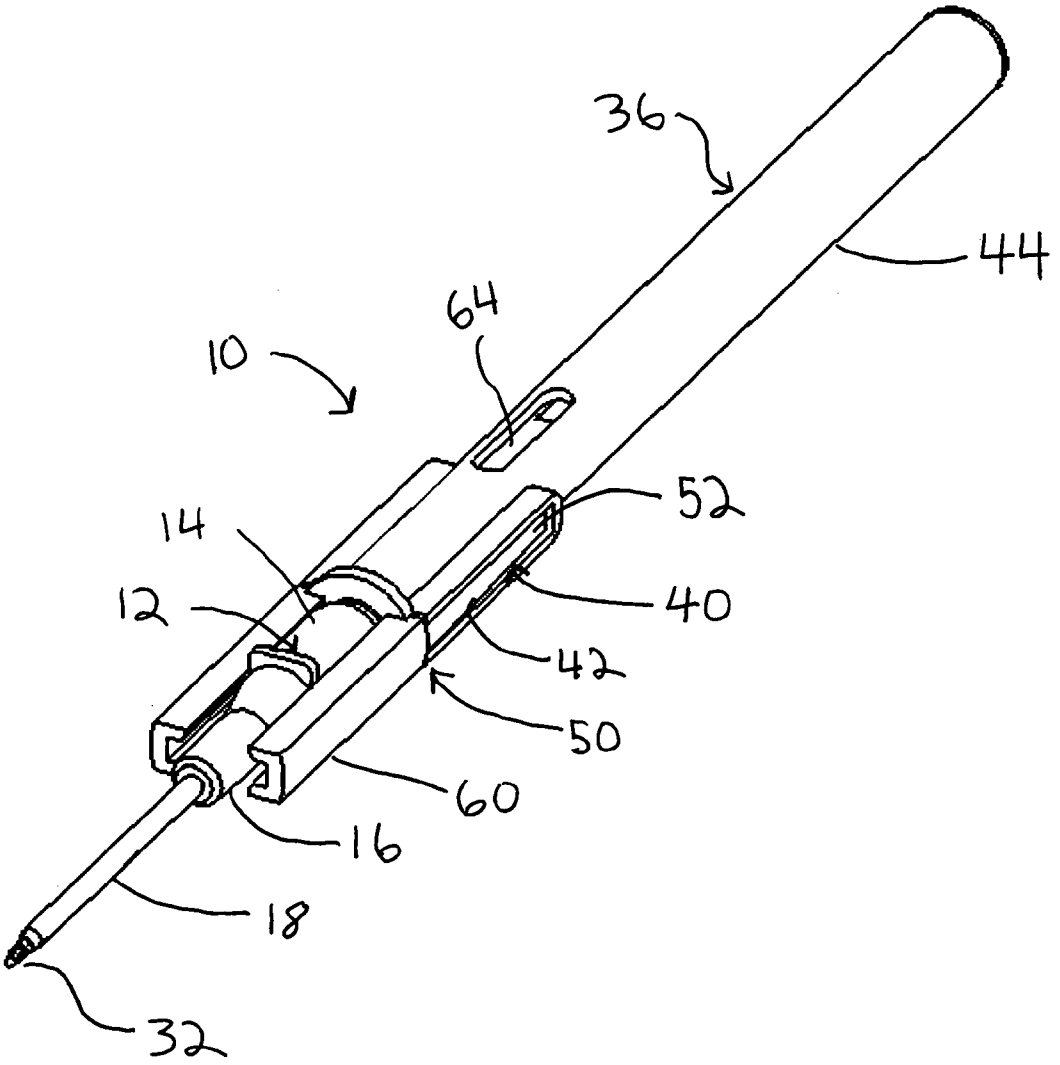


Figure 1

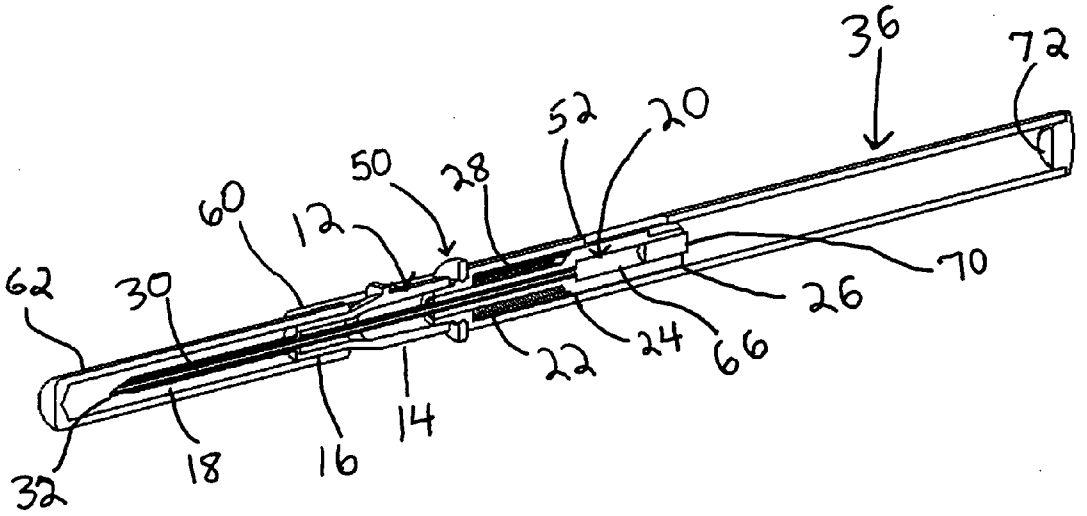


Figure 2

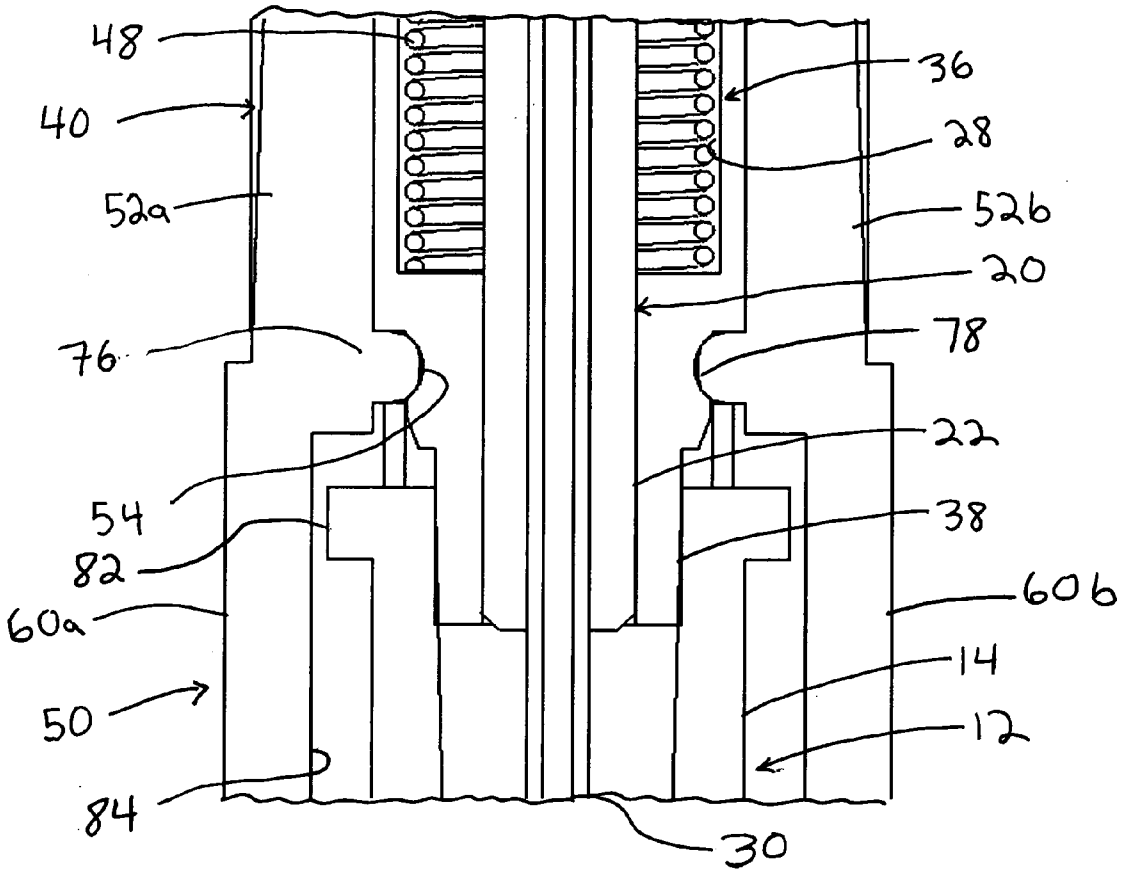


Figure 3

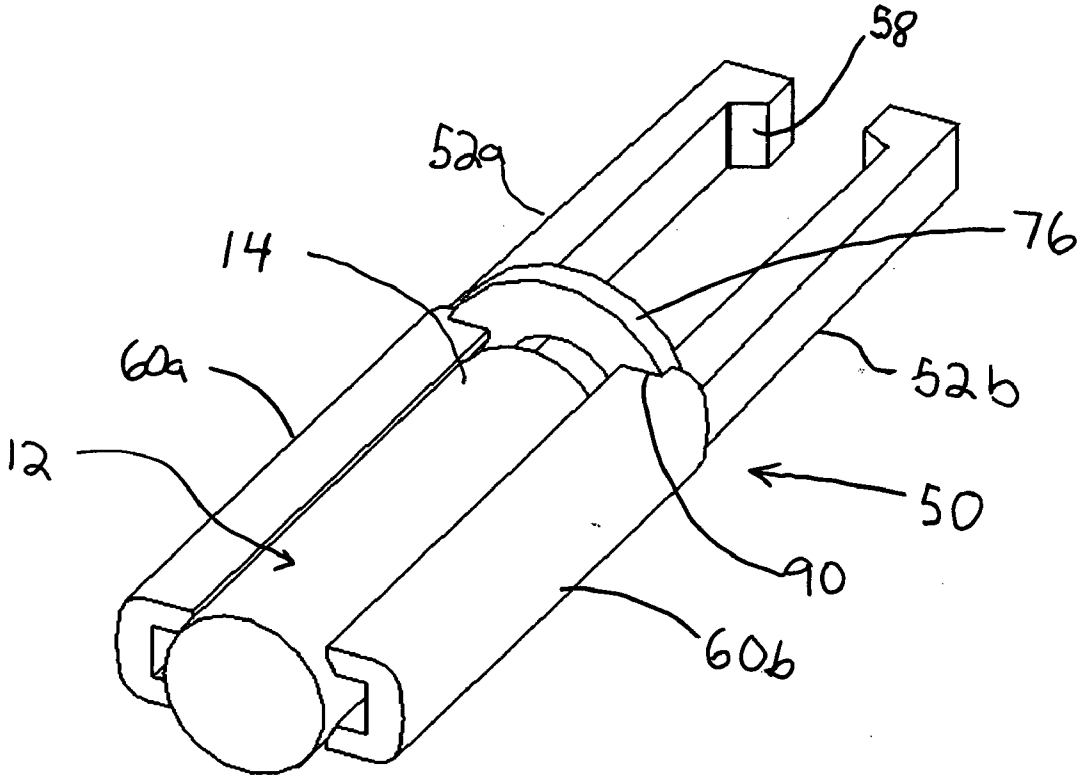


Figure 4

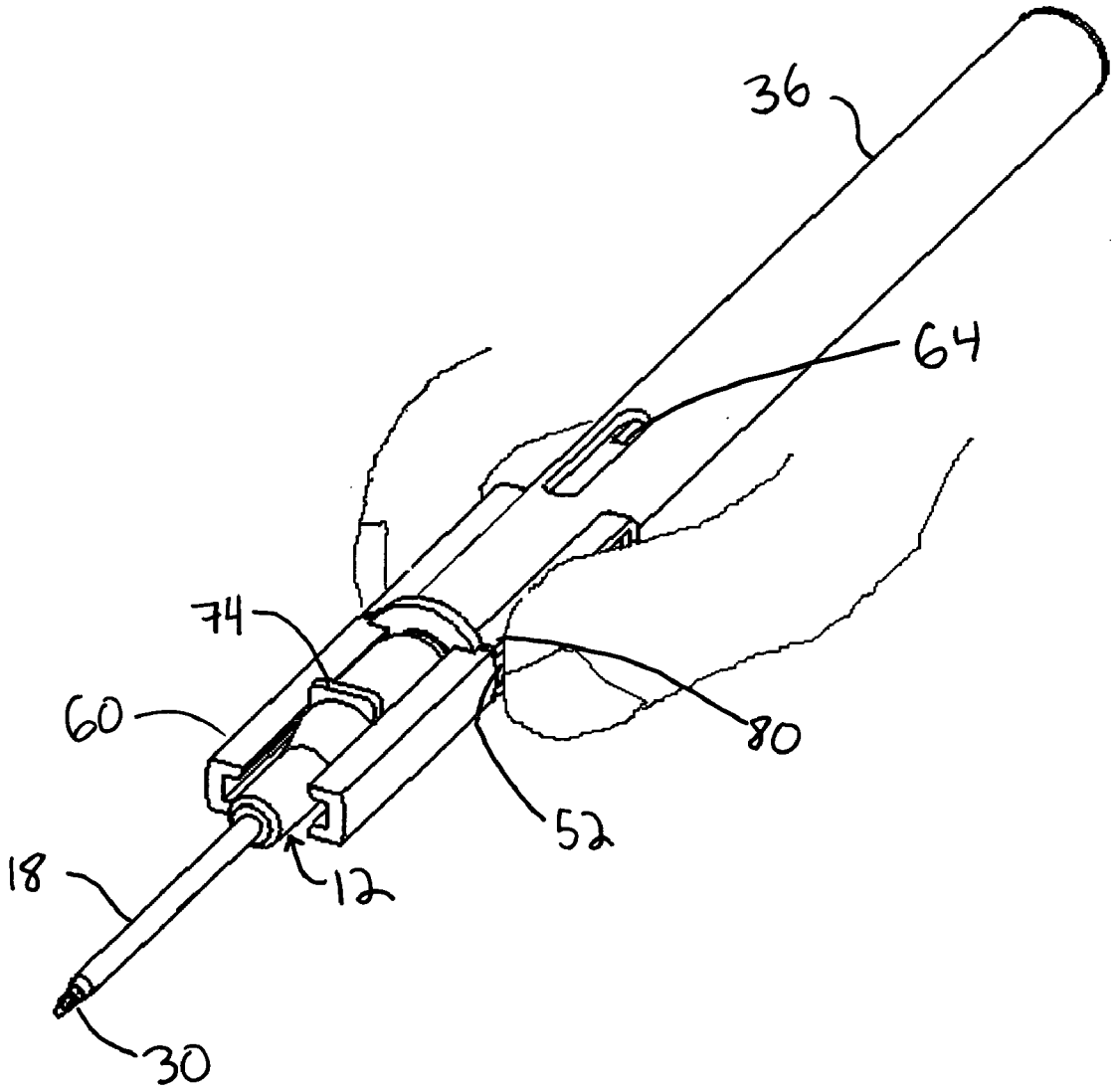
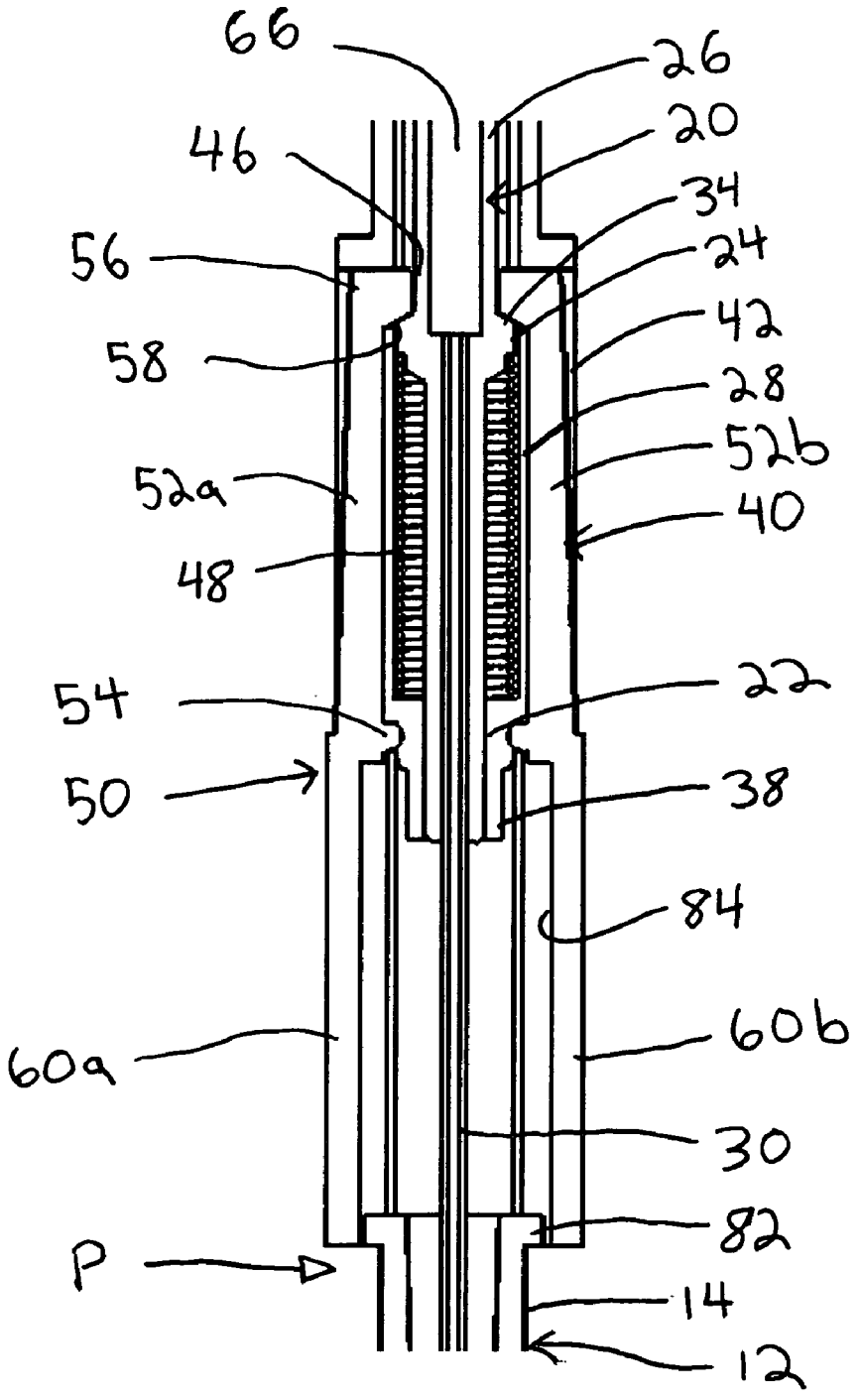


Figure 5


66
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42
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52b
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Figure 6

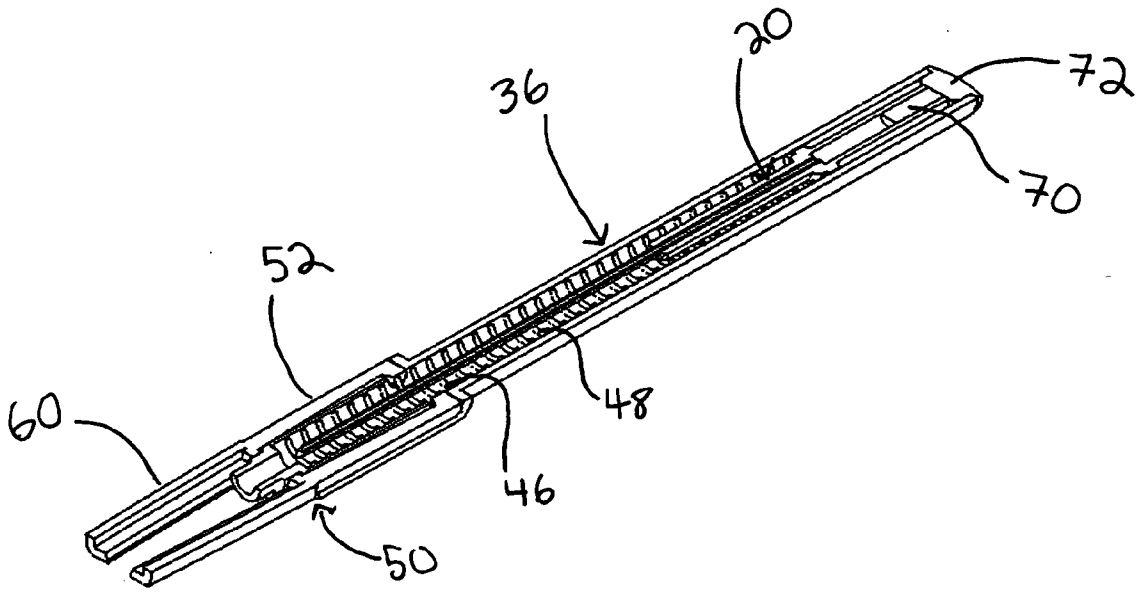

Figure 7

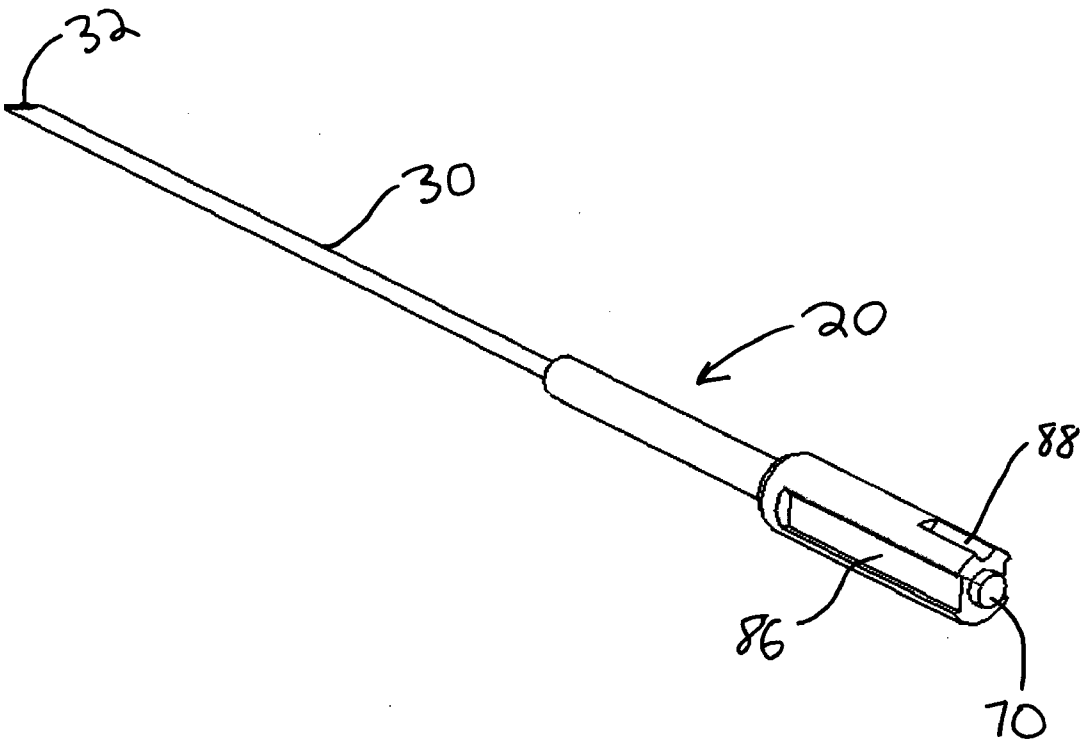

Figure 8

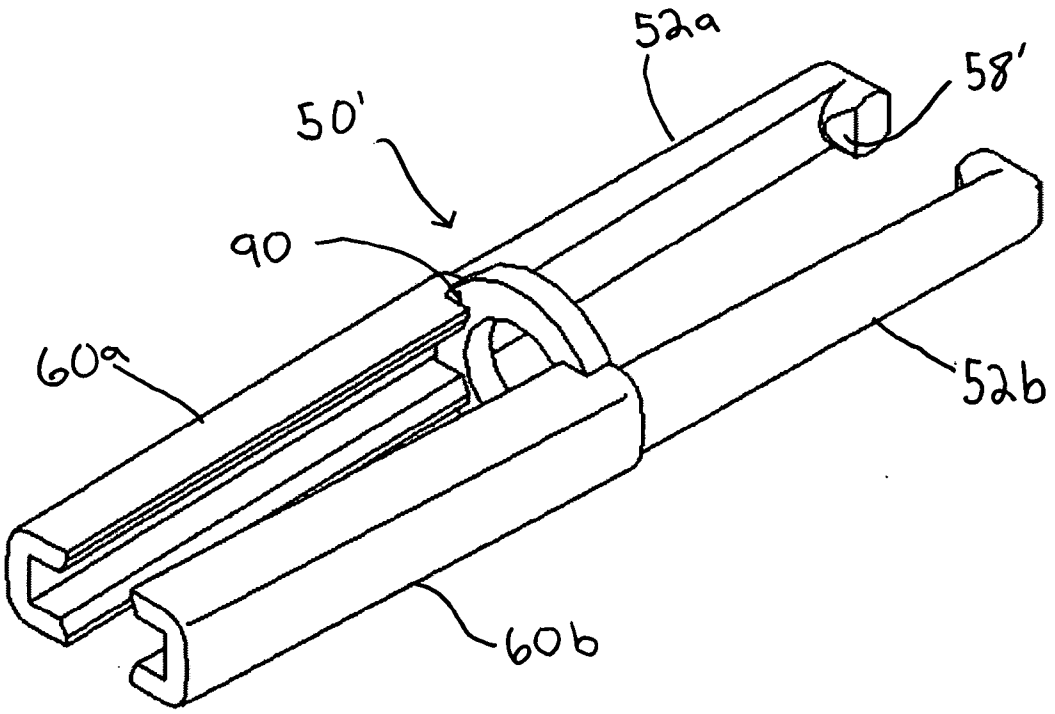

Figure 9

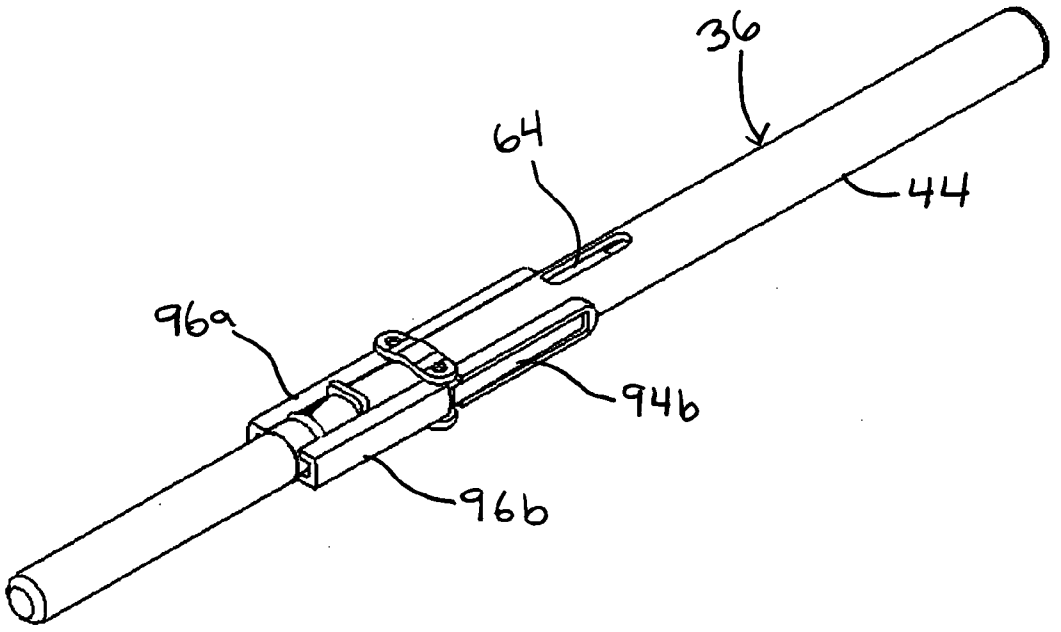

Figure 10

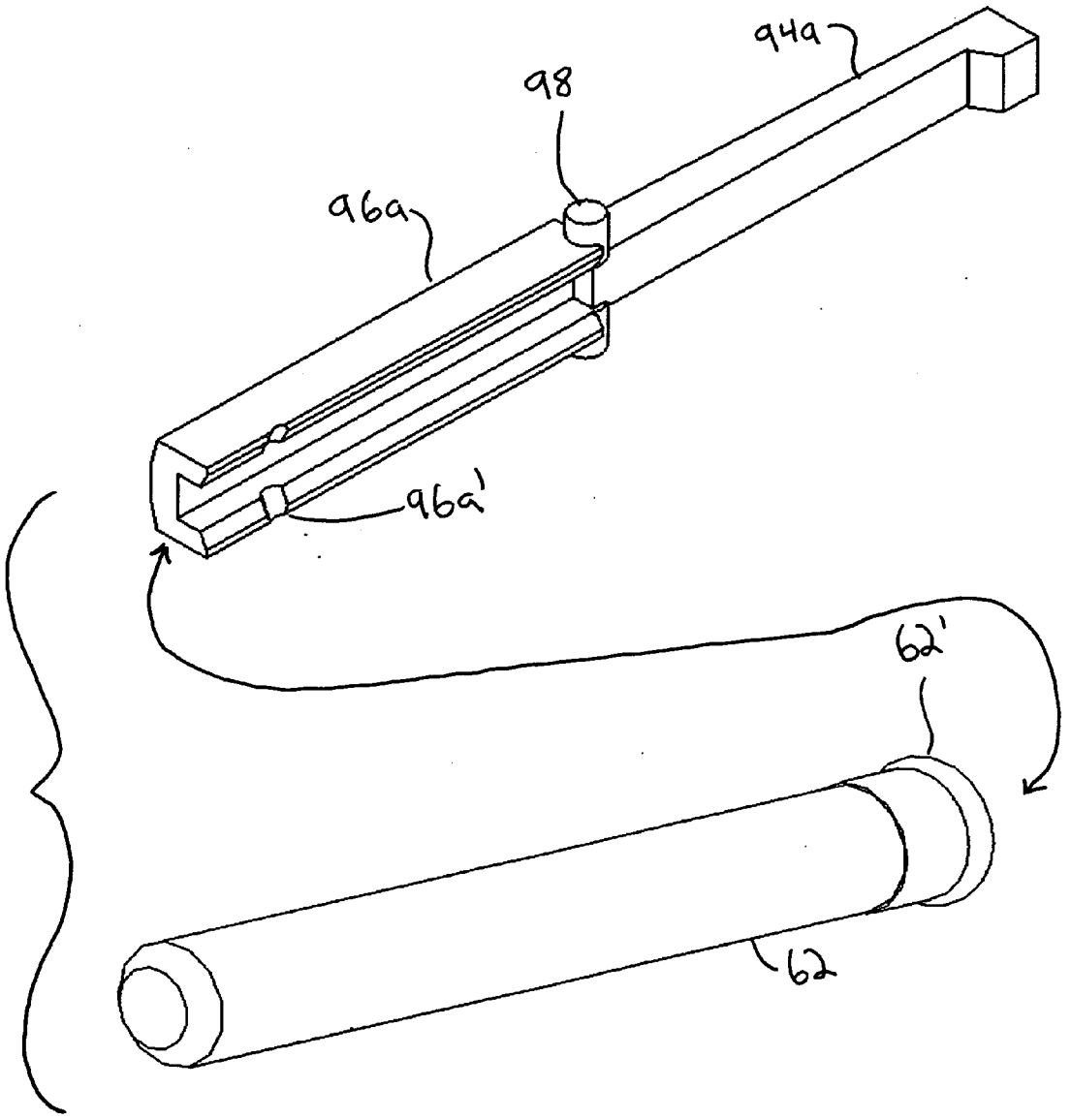

Figure 11

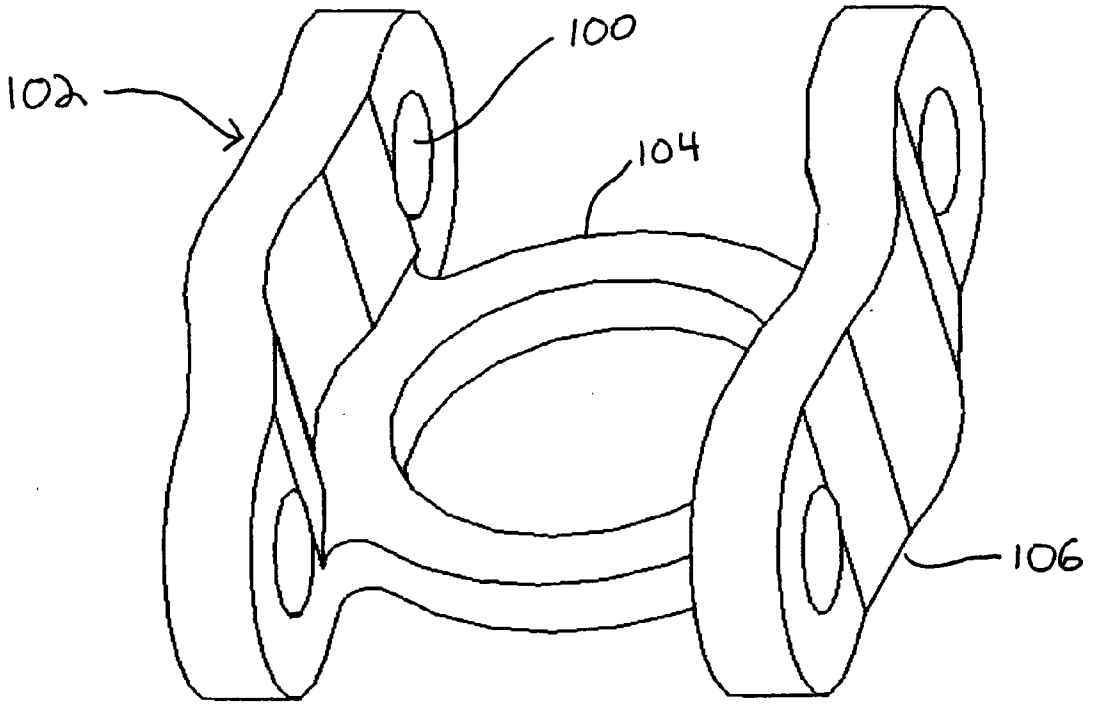

Figure 12

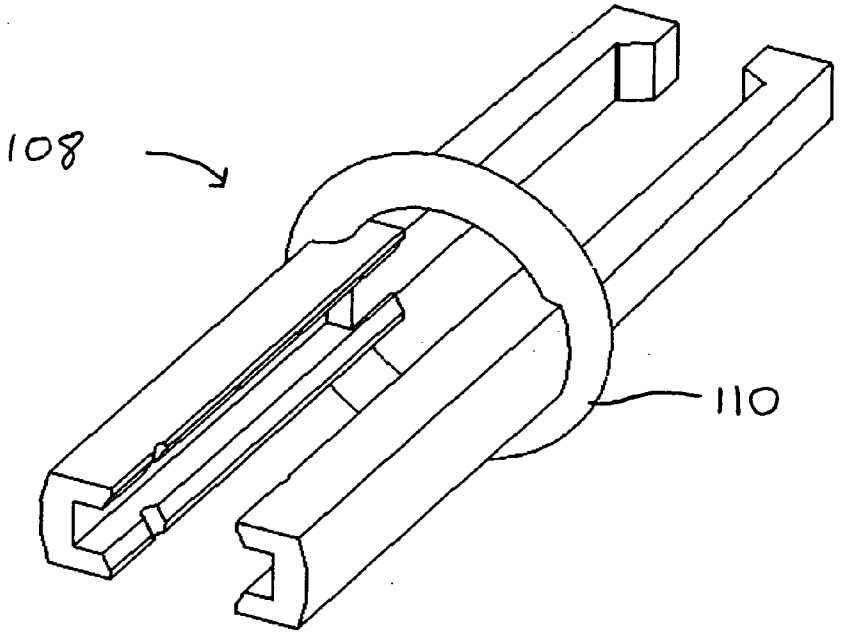

Figure 13

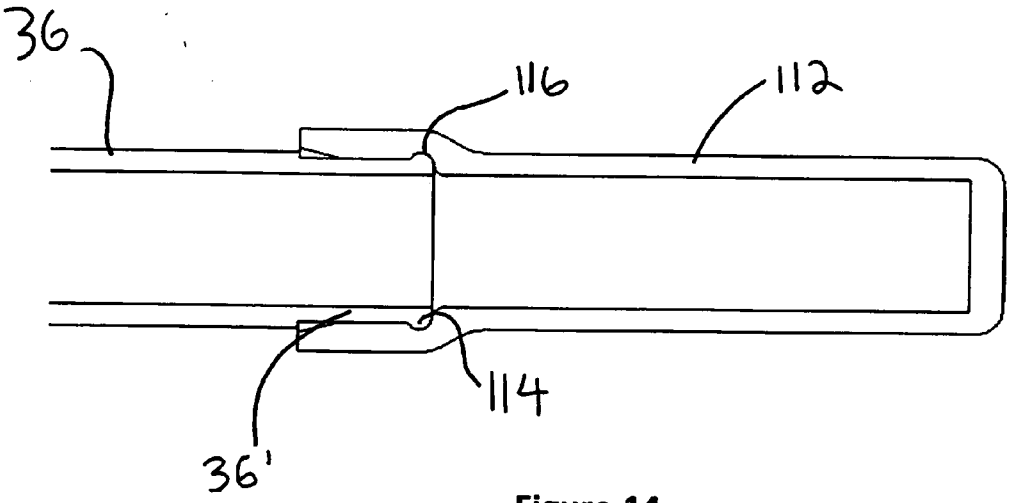

Figure 14

SAFETY CANNULA WITH AUTOMATIC RETRACTABLE NEEDLE

BACKGROUND

[0001] The present invention relates to intra venous (IV) cannulas that incorporate a safety feature whereby the needle is retracted after the cannula has been fully inserted into the patient.

[0002] A typical IV cannula features a steel needle with a sharp tip protruding through a slightly larger diameter flexible cannula tube. After the skin has been penetrated and the flexible tube inserted, the needle can be removed and discarded. There are however two major areas of concern. First there is a danger of injury because of the exposed sharp tip and secondly there is also a risk of infection because the outside diameter of the needle which was in contact with patient's blood might be contaminated. Safety cannulas are known in which if the needle was removed from the patient following proper procedure, the needle tip will remain within a special cavity in the needle carrier, where a protective flap pivots into position. Such safety cannulas are somewhat complex, but more importantly, if the proper procedure is not carefully followed, it is also possible to remove the needle without triggering the automatic cover flap because the separation between the cannula housing and the needle carrier can occur in more than one place.

[0003] Yet another disadvantage with the above described cannula arises from the needle diameter being deformed in one location to prevent the metallic needle tip protection shield from slipping off the needle and exposing the sharp tip. This deformation however obstructs the flow through the needle so blood has to flow through the gap between needle and the flexible tube and because of that it can take longer before the blood flows into the cannula body chamber, thereby confirming that the target was indeed been hit and the needle can now be removed.

SUMMARY

[0004] The present invention effectively overcomes these functional disadvantages while substantially reducing the number of components required for assembly.

[0005] In a general aspect, the invention is directed to an intravenous cannula device having a cannula body, a needle carrier, and a needle carrier container nested in series, wherein the needle carrier is spring loaded toward the container, and the container carries an external lever assembly that triggers the spring as the cannula is pushed forward of the container toward full insertion in the patient, whereby the released spring drives the needle carrier including needle into the container

[0006] The disclosed device has a cannula body with a forward projecting tube, a needle carrier that is spring loaded toward a needle container having a receiving compartment that extends behind the needle carrier, and a lever assembly having locking arms that extend longitudinally along the exterior of the needle container. Each arm has a base that is longitudinally fixed with respect to the container, a free end having a hook that passes through openings in the container and engages a shoulder on the needle carrier to hold the needle carrier and thus prevent entry into the compartment of the container, and a trigger for releasing the spring, actuated by longitudinal motion of the cannula body relative to the container.

[0007] Preferably, the container, needle carrier, and lever assembly are longitudinally slidable together relative to the cannula body such that beyond a predetermined position of the container relative to the cannula body the trigger is actuated and thereby releases the hooks from the shoulder, whereby the spring drives the needle carrier including needle into the cavity of the container.

[0008] The implementing embodiments of a safety cannula device as disclosed herein, include a hollow cannula body having an elongated tube extending forward from the body. A tubular needle carrier is axially aligned behind cannula body, and supports a needle that extends through the cannula body and cannula tube to a free end that projects forwardly of the cannula tube. A tubular needle container is fixed to and encapsulates the needle carrier and has a front portion slidingly engaging the cannula body, an intermediate portion defining a cavity, and a back portion having a length at least equal to the extension of the needle through the cannula tube. In the cavity, the needle carrier has a shoulder and a spring acts between the container and a shoulder on the needle carrier, biasing the carrier toward the back portion of the container. The arms of the lever assembly extend longitudinally along the exterior at the intermediate portion of the needle container, each arm having a base that is longitudinally fixed with respect to the container, a free end having a hook that passes through one of said openings and engages the shoulder.

[0009] The cannula device can be held by a nurse between the thumb and middle finger at the locking arms. After blood is drawn through the needle and appears in a view window, the nurse gradually pushes the cannula off the needle. The container, needle carrier, and lever assembly together slide relative to the cannula body such that beyond a predetermined position of the cannula relative to the container the trigger is actuated and thereby releases the hooks from the shoulder, whereby the spring drives the needle carrier including needle into the back portion of the container.

[0010] The advantages include:

- **[0011]** Passive safety feature (automatic needle retraction)
- **[0012]** Lost motion provides partial needle tip retraction and by that provides support for smaller diameter cannula tubes
- **[0013]** Complete encapsulation of potentially contaminated needle after use
- **[0014]** Unchanged cannula (catheter) body (identical with current production cannulas)
- **[0015]** Identical components can be used with either wingless or wing type cannulas
- **[0016]** Modular design option minimizes tooling costs
- **[0017]** Aesthetically pleasing, compact design

BRIEF DESCRIPTION OF THE DRAWING

[0018] Embodiments will be described with reference to the accompanying drawing, in which:

[0019] FIG. **1** is an oblique view of a first embodiment of a complete cannula device as removed from a sterile pouch, ready for use;

[0020] FIG. **2** is an oblique view similar to FIG. **1**, in longitudinal section;

[0021] FIG. **3** is a longitudinal section view of the region of the device where the cannula body, needle carrier, carrier container and lever assembly are interconnected in the condition shown in FIG. **2**;

[0022] FIG. **4** is an oblique schematic view showing how the locking arms of the lever assembly are prevented from pivoting radially outward so long as the trigger arms are in contact with the canula body in the condition shown in FIG. **2**;

[0023] FIG. **5** is an illustration of how the medical technician can hold the device in the condition shown in FIG. **2**, immediately before insertion of the needle into the patient;

[0024] FIG. **6** is a longitudinal section view showing a condition after the technician has pushed the cannula body forward relative to the container, needle carrier, and lever assembly, immediately before triggering of the spring release of the lever assembly;

[0025] FIG. **7** shows the safe condition following the exit of the cannula body from the container, in which the lever assembly has been triggered and the spring has driven the needle carrier with needle fully into the container;

[0026] FIG. **8** is an oblique view of the preferred needle carrier;

[0027] FIG. **9** shows the details of the type of lever assembly of the first embodiment, with an alternative shape for the hooks;

[0028] FIGS. **10-12** show a second embodiment for the lever assembly;

[0029] FIG. **13** shows a third embodiment of the lever assembly; and

[0030] FIG. **14** shows a variation of the container, having a variable length snap extension to accommodate different length needles.

DETAILED DESCRIPTION

[0031] FIGS. **1-8** show a first embodiment of a safety IV cannula according to the present disclosure. The safety cannula device **10** comprises a hollow cannula body **12** having a larger diameter back portion **14**, a smaller diameter front portion **16**, and an elongated tube **18** extending forward from the front portion of the body. A tubular needle carrier **20** having front **22**, intermediate **24**, and back portions **26**, is nested on the body, with the front portion **22** within the back portion **14** of the cannula body and the intermediate portion **24** longitudinally spaced in cavity **28** behind the back portion **14** of the cannula body. The front portion **22** supports a needle **30** that extends through the cannula body **12** and cannula tube **18** to a free end **32** that projects forwardly of the cannula tube **18**. The intermediate portion **24** forms a shoulder **34** in cavity **28**.

[0032] A tubular needle container **36** is nested with the cannula body **12** and the needle carrier **20**, having a front portion **38** captured between the front portion **22** of the needle carrier and the back portion **14** of the cannula body, an intermediate portion **40** having a plurality of elongated external channels **42**, and a back portion **44** defining a compartment having a length at least equal to the extension of the needle **30** through the cannula tube **18**. The channels **42** each have a radial opening **46** into the cavity **28**, adjacent to the shoulder **34** on the needle carrier. A helical or coil spring **48** has one end seated near the front end **38** of the carrier at the forward end of the cavity **28** that extends through the intermediate portion **40** of the container. The other end of the spring **48** acts axially on the needle carrier **20**, biasing the carrier toward the back portion **44** of the container.

[0033] A lever assembly **50** has locking arms **52***a*, **52***b* that extend longitudinally in respective channels **42** of the needle container **36**, each arm having a base **54** that is longitudinally fixed with respect to the container **36**, and a free end **56** having a hook **58** that passes through one of the openings **46** and engages the shoulder **34** of the needle carrier. The shoulder **34** imposes a radially outward force component on each hook **58** while a longitudinally directed force component resists the bias of the spring and prevents the needle carrier **20** from entering the back portion **44** of the container **36**, until the locking arms are triggered. The trigger **60** is actuated passively and automatically by longitudinal motion of the cannula body **12** relative to the container **36**, as the medical technician advances the cannula into the patient. This is possible because the container **36**, needle carrier **20**, and lever assembly **50** together are longitudinally slidable relative to the cannula body **12** such that beyond a predetermined position P of the cannula body **12** relative to the container (or trigger) the trigger **60** is actuated and thereby adds another radially outward force component to the hooks **58** such that the hooks move radially outward from the shoulder **34**. This releases the intermediate portion **24** of the needle carrier, whereby the spring **48** drives the needle carrier **20** including needle **30** into the back portion **44** of the container. Preferably, the trigger comprises a plurality of trigger arms **60***a*, **60***b* in alignment with the corresponding plurality of locking arms **50***a*. **50***b*, with the trigger arms extending forward beyond the front portion **38** of the container.

[0034] FIG. **1** shows that the sharp needle tip **32** initially projects from the cannula tube **18**. The device is, however, initially distributed in sterile packaging with a tubular safety cover **62** as shown in FIG. **2**. The cover **62** is held by friction between the front portion **16** of the cannula body and the front portion of the trigger arms **60** that overhang the front portion **38** container. This cover must be removed and discarded before the use.

[0035] In use, the device **10** automatically retracts the needle carrier **20** into the container **36**. The locking arms **52** and trigger arms **60** are connected via a circular ring **76**. The inner circumference **76** defines the base **54** of each locking arm, and is captured in a groove **78** on the exterior of the front portion **38** of the container **36**, thus fixing the lever assembly **50** with respect to the container **36**. The central ring **76** of the integral lever pair is snapped into a corresponding circular groove **78**. As a result, after the needle container **36** is removed from the cannula body **12** the lever assembly **50** will remain attached to the container, avoiding loose parts.

[0036] A view window **64** is provided on the container **36**, where the transparent back portion **26** of the needle carrier forms an axially extending bore or chamber **66**. A porous plug **70** is located at the back end of the chamber and protrudes about 1 to 2 mm beyond the back edge of the carrier. This plug **70** has a dual function. The porosity of the plug allows air displaced by the blood flowing into the view chamber **66** after the sharp tip **32** has penetrated a patient's vein to escape and it also dampens the impact against the back wall **72** of container after the spring **48** has been released.

[0037] The cannula device can be held by a nurse between the thumb and middle finger at the container alongside the locking arms **52**. After blood is drawn through the needle **30** and appears in the view window **64**, the nurse gradually pushes the cannula **12** off the needle carrier **36**, preferably by pushing with the index finger on external tab **74** formed on the cannula body **12**, and accessible between the trigger arms **60** of the lever assembly. The container **36**, needle carrier **20**, and lever assembly **50** together slide relative to the cannula body **12** such that beyond a predetermined position P the trigger **60** is actuated and thereby releases the hooks **58** from the shoul-

der **34**, whereby the spring **48** drives the needle carrier **20** including needle **30** into the back portion **44** of the container. Preferably, the trigger actuates when the back end of the cannula body passes the front ends of the trigger arms **60**.

[0038] The channel walls **80** are radially outside the neutral position of the locking arms **52**. Because the walls act as barriers, the locking arms are able to open up and pull the hooks **58** off the shoulder **34**, even if the nurse continues to hold the device as shown in FIG. **5**. If the barriers **80** were the same height or lower than the locking arms **52** then the nurse would squeeze the levers directly which could prevent or delay unhooking at the shoulder **34**.

[0039] As shown in FIG. **4**, each locking arm **52** and its aligned trigger arm **60** is connected through ring **76** to form one long lever that pivots at the ring. The radial outward acting force generated by the spring tries to spread the locking levers **52**. This is however not possible so long the cannula body **12** (represented here as a cylinder) prevents the trigger arms **60** from moving closer together. Once the cylinder is removed the locking arms open up and release the spring. Until this occurs, the radial force is trying to stretch the connecting ring **76** but because this radial force is very small (about 0.04 N or 1.4 oz) and the rigidity of the connecting ring in this direction is adequate no deformation takes place. The rigidity of the ring in the arm bending direction is however small and the ring will deform easily.

[0040] By characterizing the lever assembly **50** in this embodiment as integral, the inventors mean that the locking arms **52***a*, **52***b*, respective trigger arms **60***a*, **60***b* and ring **76** are either formed as a unitary part or formed of distinct components that are substantially permanently joined. In this context, permanently joined means the lever assembly **50** is self-contained in normal use, i.e., the components are not expected to come apart.

[0041] FIG. **3** shows the initial relationship of the cannula body **12** to the lever assembly **50**, container **36**, and needle carrier **20** and FIG. **6** shows this relationship at the moment just before the back portion **14** of the cannula **12** exits the lever assembly **50** to thereby release the spring. The cannula **12** has external ears **82** that ride in internal grooves **84** of the trigger arms. The ears need not bear radially against the grooves. The reason for the ears **82** riding in and being supported by the grooves **84** is to prevent premature spring release. When the needle container **36** is moved back by the thumb and the middle finger as shown in FIG. **5** the index finger (not shown) is holding the cannula body **12** by the protrusion **74**. Especially with thin needles and in the absence of these grooves **84**, it is possible that the force applied by the index finger inadvertently deflects the needle and by that laterally pushes the cannula body out of engagement with, and thereby prematurely triggering, the trigger arms **60**.

[0042] Because of the inclination of the surfaces on both parts **58**, **34** the spring force creates a radial force component trying to spread the levers which however is prevented so long the cylindrical portion of cannula body **12** is captured by the trigger arms **60** of the lever assembly **50**.

[0043] Once the ears **82** completely exit the guide grooves **84**, the radial force component at the shoulder **34** arising from the bias of the spring **48** will spread the locking arms **52** and release the spring. Any potential opposite radial force appearing between the hooks **58** due to deformation of the connecting ring **76** after the spring is released should be minimized to insure full retraction of the needle. The force must not be able to stop the motion by interference with the spring coils.

[0044] As the spring is never in contact with blood a lesser grade of stainless steel can be used instead of otherwise required medical grade stainless steel.

[0045] The lost motion of the cannula **12** until spring release allows for full insertion of the cannula tube **18** in the vein because the tube is partially supported by the more rigid needle **30**. This feature is especially important for the smaller diameter cannula tubes which lack the rigidity to support insertion forces and because of that could collapse before the tube is fully inserted.

[0046] FIG. **7** shows the condition of the container **36**, needle carrier **20**, and lever assembly **50** after the cannula **12** was removed and the spring **48** was released. This shows the ideal natural (neutral) shape of the components of the lever assembly **50**, i.e., the trigger arms **60** are inclined toward the axis while the locking arms **52** are contained substantially entirely within the openings **46** in the carrier **36**.

[0047] As shown in FIG. **8**, the needle carrier **20** can have two lateral grooves **86** or similar recesses, which are situated in back of the shoulder **34** of the assemble device and accommodate the hooks **58** of both locking levers **52** to keep the spring compressed. A visual or structural marker, such as notch **88**, can also be provided to insure proper orientation of the obliquely cut needle tip **32** during assembly. The locking arm channels **42** of the needle carrier are spaced 180° apart and because of that it would be possible to install the needle carrier **20** with the needle tip **32** wrongly pointing up. In order to prevent this mistake, the notch **88** on the needle carrier is used as a signal indicating the correct position of the sharp point. This reference notch or groove can engage with a corresponding protrusion of the assembly tool to insure the proper orientation.

[0048] FIG. **9** shows the details of the type of lever assembly of the first embodiment, with an alternative shape for the hooks. In this lever assembly **50'**, there are only two differences relative to FIG. **4**. The hooks **58** of FIG. **4** have a parabolic surface, whereas the hooks of FIG. **9** have a rectangular surface. FIG. **9** also shows in greater detail how the lever assemblies **50** and **50'** are composed of three parts, i.e., one lever consisting of arms **52***a* and **60***a;* another lever consisting of arms **52***b* and **60***b;* and a central ring **76** snap fit into notches or grooves **90** in arms **60** at the transition to arms **52**.

[0049] FIGS. **10-12** show another embodiment **92** of the lever assembly, consisting of one lever having integral locking and trigger arms **94***a*, **96***a* and another lever having integral locking and trigger arms **94***b*, **96***b*. At the transition between the arms of each lever, a pair of opposed posts **98** project laterally. The posts **98** engage respective pairs holes **100** in cage **102**. The cage **102** has a central ring **104** that is coaxial with the longitudinal axis of the device, and two wings **106** that extend tangentially to the ring and transverse to the axis of the device. Each wing has a hole at opposite ends, whereby four posts **98** engage four holes **100**. In the assembled condition, the wings and posts define a four sided frame that firmly surrounds container **20**. Each pair of posts can pivot at the respective pair of holes. The advantage of this embodiment is the absence of any radial force which could possibly prevent complete retraction of the needle as a consequence of the locking hooks interfering with the coils of the spring.

[0050] FIG. **11** also shows that the front end **96***a'* of each the trigger arm can have a detent type cooperation with the back

end **62'** of the safety cover, to substitute for or enhance the previously described friction fit.

[0051] FIG. **13** shows a third embodiment **108** of a lever assembly, wherein the cage of FIG. **11** has been reduced to the form of a simple elastic ring **110** at the transition (pivot point) of the lever arms. The ring **110** provides a radially inward force at its entire inner surface, thereby securing the lever assembly **108** longitudinally on the container but permitting the necessary pivoting action to release the spring. This embodiment has the advantage of inexpensive tooling, however the components will likely fall apart after the cannula has been removed from the patient.

[0052] FIG. **14** shows an alternative embodiment of the container, in which an extension tube **112** is snap fit on the open back end **36'** of the container **36**. Preferably, the back end **36'** has a reduced OD that easily fits into the ID of a complementary bore ID at the front of the tube. Cooperating positive **114** (protruding) and negative **116** (receding) structure care engaged as the tube is slid onto the back end **36'** of the container **36**. Any form of detent type cooperation is suitable for this purpose. This embodiment provides a very simple variable length snap on extension of the length of the container **36**. As a consequence, the tooling for the fabrication and assembly of the lever assembly and associated triggering components can be identical for cannula devices having different lengths of needles.

1. An intravenous cannula device comprising:
- a cannula body having a frontally projecting tube for insertion in a patient;
- a needle carrier axially aligned behind the cannula body and having a needle in and projecting from the cannula tube;
- a needle container in coaxial, nested relation to the cannula body and the needle carrier;
- wherein the needle carrier is spring loaded backward away from the cannula, and the container carries an external lever assembly that triggers the spring as the cannula body is pushed forward of the container toward full insertion in the patient, whereby the triggered spring drives the needle carrier including needle fully into a compartment of the container.

2. The cannula device of claim **1**, wherein the lever assembly has locking arms that extend longitudinally in respective channels of the needle container, each locking arm having
- a base that is longitudinally fixed with respect to the container;
- a free end having a hook that passes through an opening in the container and engages a shoulder on the needle carrier, which hook resists the load of the spring and prevents the needle carrier from entering the compartment of the container; and
- a trigger actuated by longitudinal motion of the cannula body relative to the container.

3. The cannula device of claim **2**, wherein said container, needle carrier, and lever assembly together are longitudinally slidable relative to said cannula body such that beyond a predetermined position of the cannula body relative to the container the trigger is actuated and thereby imparts a radially outward force component to the hooks such that the hooks move radially outward from the shoulder and release the needle carrier, whereby the spring drives the needle carrier including needle into the compartment of the container.

4. The cannula device of claim **2** wherein the lever assembly consists essentially of:
- one lever defining a locking arm and integral, longitudinally aligned trigger arm;
- another lever defining another locking arm and integral, longitudinally aligned trigger arm;
- a central ring having an outer portion that fixedly engages the levers and an inner portion defining said base that fixedly engages the container and thereby longitudinally fixes the lever assembly to the container.

5. The cannula device of claim **2**, wherein the lever assembly consists essentially of:
- one integral lever having a locking arm that transitions into a trigger arm;
- another integral lever having a locking arm that transitions into a trigger arm;
- each lever having a pair of posts projecting laterally at the respective transitions and defining said base;
- a cage having a central ring that is coaxial with the longitudinal axis of the device, and two wings that extend tangentially to the ring and transverse to the axis of the device, each wing having a pair of holes;
- whereby the pairs of posts engage the pairs of holes such that in the assembled condition, the wings and posts define a four sided frame that firmly surrounds and thereby longitudinally fixes the lever assembly to the container.

6. The cannula device of claim **2**, wherein the lever assembly consists essentially of:
- one integral lever having a locking arm that transitions into a trigger arm;
- another integral lever having a locking arm that transitions into a trigger arm;
- an elastic ring surrounding and providing a radially inward force on the levers at the transitions, which force is transmitted to the container through the transitions such that the transitions define said base and secure the lever assembly longitudinally on the container.

7. The cannula device of claim **2**, wherein the container comprises a body having an open back end and a variable length extension including an extension tube having an open front end in overlapping engagement with the open back end of the container body and a closed back end.

8. The cannula device of claim **7**, wherein
- the back end of the container body has a reduced OD and the front portion of the extension tube has a complementary ID that fits on the back end of the container; and
- the back end of the container body and the front portion of the extension tube have cooperating positive and negative detent structures that are engaged as the extension tube is slid onto the back end of the container.

9. A safety cannula device comprising:
- a hollow cannula body having an elongated tube extending forward from the body;
- a tubular needle carrier axially aligned behind cannula body, and having front and back portions, wherein the needle carrier supports a needle that extends through the cannula body and cannula tube to a free end that projects forwardly of the cannula tube, and wherein the needle carrier has a shoulder;
- a tubular needle container fixed to and encapsulating the needle carrier and having a front portion slidingly engaging the cannula body, an intermediate portion defining a cavity in which said shoulder is located, and a back portion defining a container having a length at least equal to the extension of the needle through the cannula

tube, and at least one radial opening in the intermediate portion, laterally of the shoulder on the needle carrier;

a spring situated within the cavity of the container and acting between the container and the needle carrier, biasing the carrier toward the back portion of the container;

a lever assembly having locking arms that extend longitudinally along the exterior at the intermediate portion of the needle container, each arm having a base that is longitudinally fixed with respect to the container, a free end having a hook that passes through one of said openings and engages the shoulder of the needle carrier to prevent the needle carrier from entering the back portion of the container, and a trigger actuated by longitudinal motion of the cannula body relative to the container.

10. A safety cannula device comprising:

a hollow cannula body having an elongated tube extending forward from the body;

a tubular needle carrier axially aligned behind cannula body, and having front, intermediate, and back portions, wherein the front portion supports a needle that extends through the cannula body and cannula tube to a free end that projects forwardly of the cannula tube, and wherein the intermediate portion has a shoulder;

a tubular needle container encapsulating the needle carrier and engaging the cannula body, having a front portion, an intermediate portion having a plurality of elongated external channels, and a back portion defining a compartment having a length at least equal to extension of the needle through the cannula tube, wherein the channels each have a radial opening laterally of the shoulder on the needle carrier;

a spring situated within the intermediate portion of the container and acting between the front portion of the container and the needle carrier, biasing the carrier toward the back portion of the container;

a lever assembly having locking arms that extend longitudinally in respective channels of the needle container, each arm having a base that is longitudinally fixed with respect to the container, a free end having a hook that passes through one of said openings and engages the shoulder of the needle carrier to prevent the needle carrier from entering the back portion of the container, and a trigger actuated by longitudinal motion of the cannula body relative to the container;

said container, needle carrier, and lever assembly together being longitudinally slidable relative to said cannula body such that beyond a predetermined position of the cannula body relative to the container the trigger is actuated and thereby releases the hooks from the shoulder, whereby the spring drives the needle carrier including needle into the compartment of the container.

11. The safety cannula device of claim **10**, wherein the back portion of the needle carrier includes two external grooves that are aligned with the channels of the container.

12. The safety cannula of claim **10**, wherein a porous plug projects axially from the back portion of the needle carrier.

13. The safety cannula of claim **11**, wherein a porous plug projects axially from the back portion of the needle carrier.

14. The safety cannula of claim **10**, wherein the back portion of the needle carrier includes a needle alignment mark.

15. The safety cannula of claim **10**, wherein the trigger includes two longitudinally extending trigger arms that contact and are slidable along the cannula body and that actuate a pivot action on the locking arms when the cannula body slides out of contact with the trigger arms at said position.

16. The safety cannula of claim of **15**, including a tubular cover having a front end that extends forward of the needle, and a back end that overlaps the front portion of the cannula body and is overlapped by front ends of the trigger arms.

17. the safety cannula of claim **15**, wherein the front end the trigger arms and the back end of the cover are engaged with a snap connection that is manually broken to remove the cover immediately before use of the cannula device.

18. A safety cannula device comprising:

a hollow cannula body having a larger diameter back portion, a smaller diameter front portion, and an elongated tube extending forward from the front portion of the body;

a tubular needle carrier having front, intermediate, and back portions, with the front portion within the back portion of the cannula body and the intermediate portion in a cavity behind the back portion of the cannula body, wherein the front portion supports a needle that extends through the cannula body and cannula tube to a free end that projects forwardly of the cannula tube, and wherein the intermediate portion forms a shoulder in said cavity;

a tubular needle container having a front portion captured between the front portion of the needle carrier and the back portion of the cannula body, an intermediate portion having a plurality of elongated external channels, and a back portion defining a compartment having a length at least equal to extension of the needle through the cannula tube, wherein the channels each have a radial opening into the cavity adjacent to the shoulder on the needle carrier;

a spring situated within the intermediate portion of the container and acting axially on the needle carrier, biasing the carrier toward the back portion of the container;

a lever assembly having locking arms that extend longitudinally in respective channels of the needle container, each arm having a base that is longitudinally fixed with respect to the container, a free end having a hook that passes through one of said openings and engages the shoulder of the needle carrier, which shoulder imposes a radially outward force component on the hook while a longitudinally directed force component resists the bias of the spring and prevents the needle carrier from entering the back portion of the container, and a trigger actuated by longitudinal motion of the cannula body relative to the container;

said container, needle carrier, and lever assembly together being longitudinally slidable relative to said cannula body such that beyond a predetermined position of the cannula body relative to the container the trigger is actuated and thereby adds another radially outward force component to the hooks such that the hooks move radially outward from the shoulder and release the intermediate portion of the needle carrier, whereby the spring drives the needle carrier including needle into the back portion of the container.

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