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(54) **SAFETY SYRINGE**

(76) Inventor: **Dennis Gordon**, Las Vegas, NV (US)

Correspondence Address:
KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614 (US)

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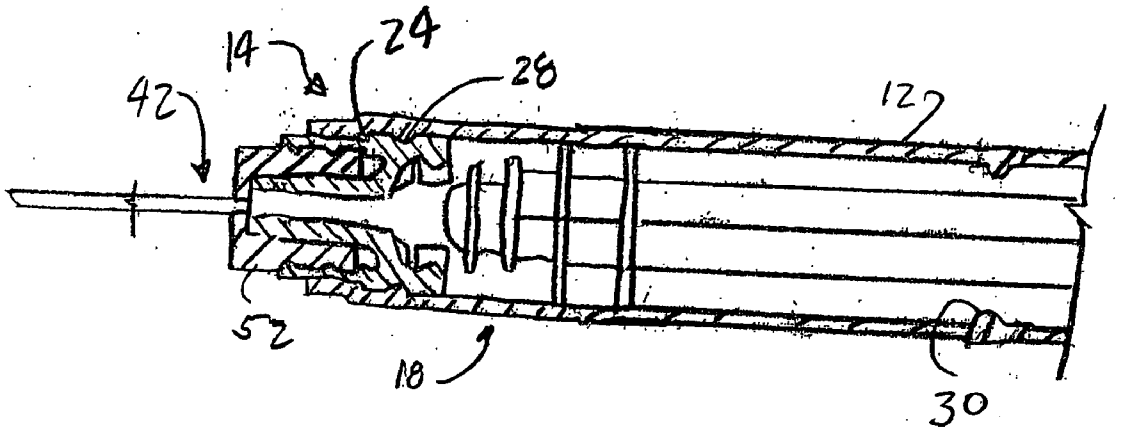
(57) **ABSTRACT**

A hypodermic syringe provides a simple mechanism for manually retracting its needle into the syringe after injection has been completed. The syringe preferably has an elastomeric barrel to exert a radial bias to seal on a retractable needle carrier and the plunger. Attachment components on the plunger and needle carrier engage such that withdrawal of the plunger releases the needle carrier for withdrawal into the syringe barrel.



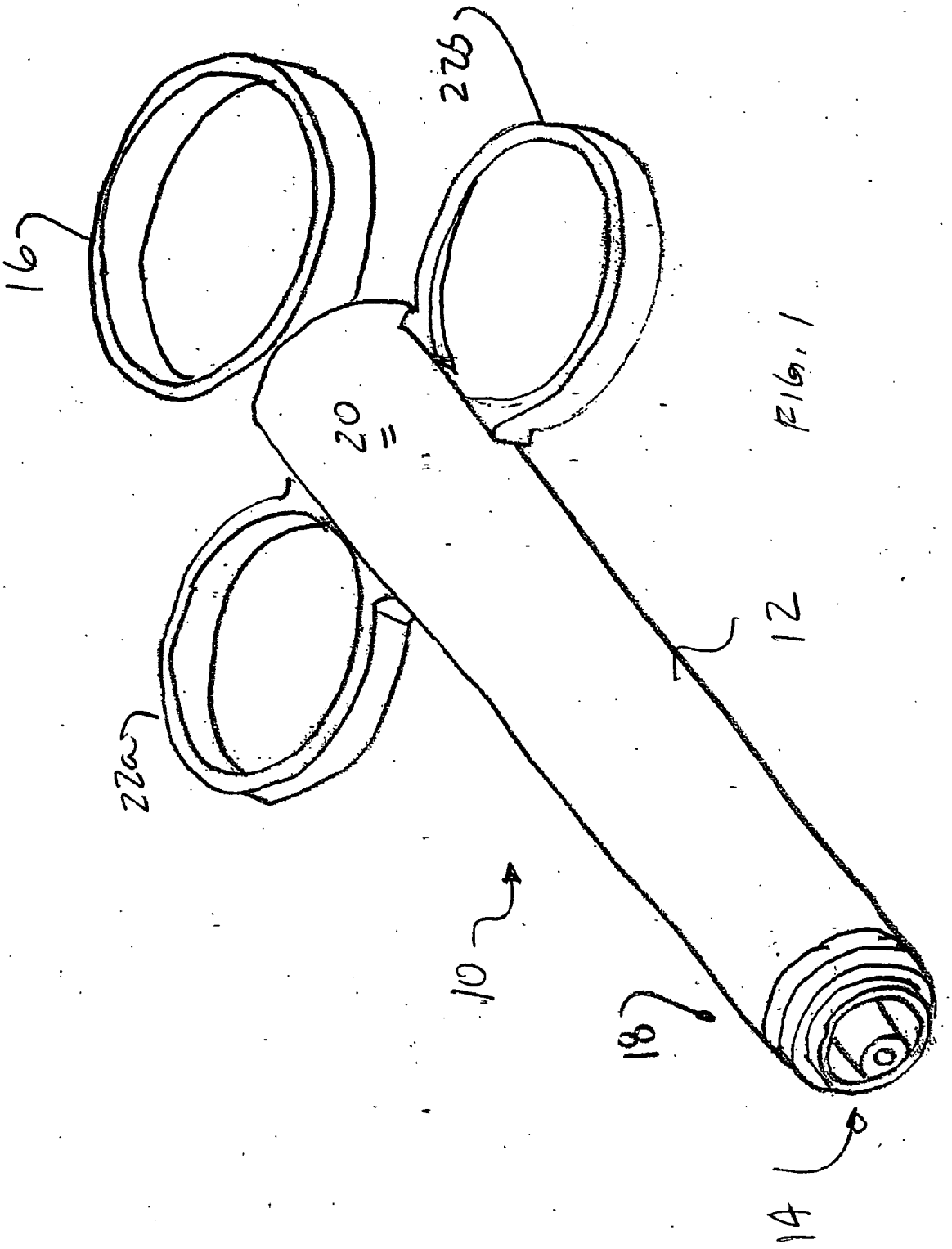
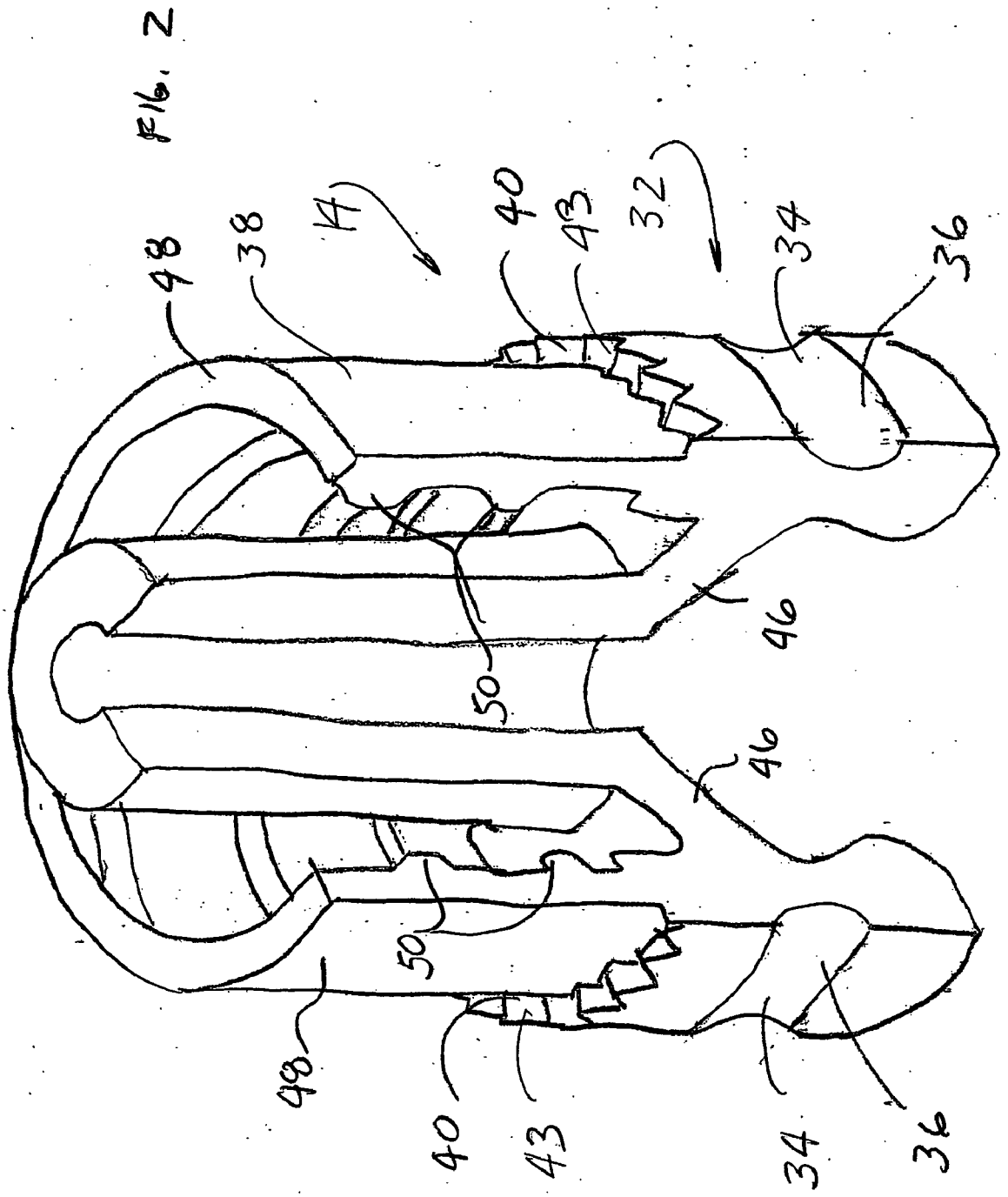


FIG. 1

FIG. 2



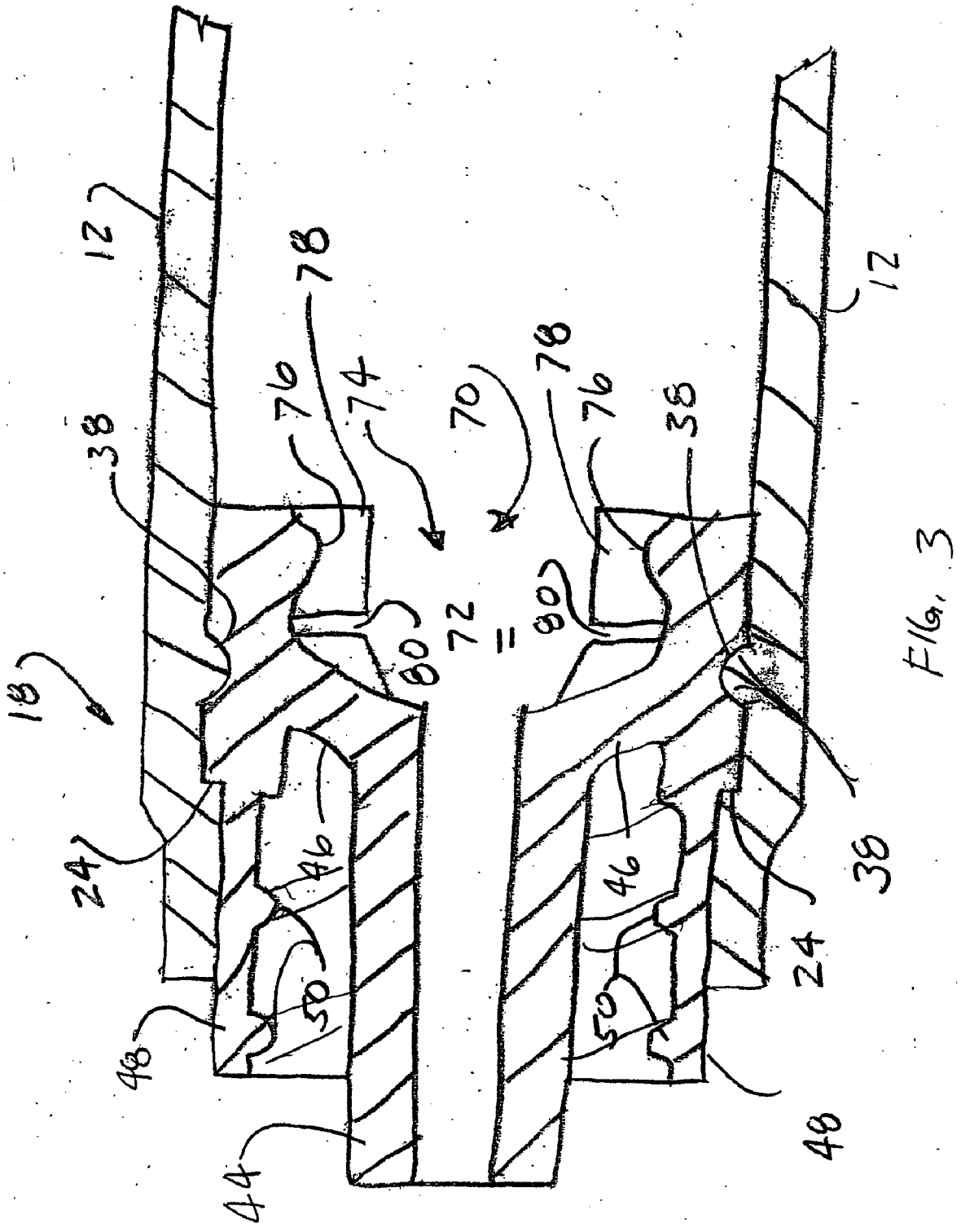


Fig. 3

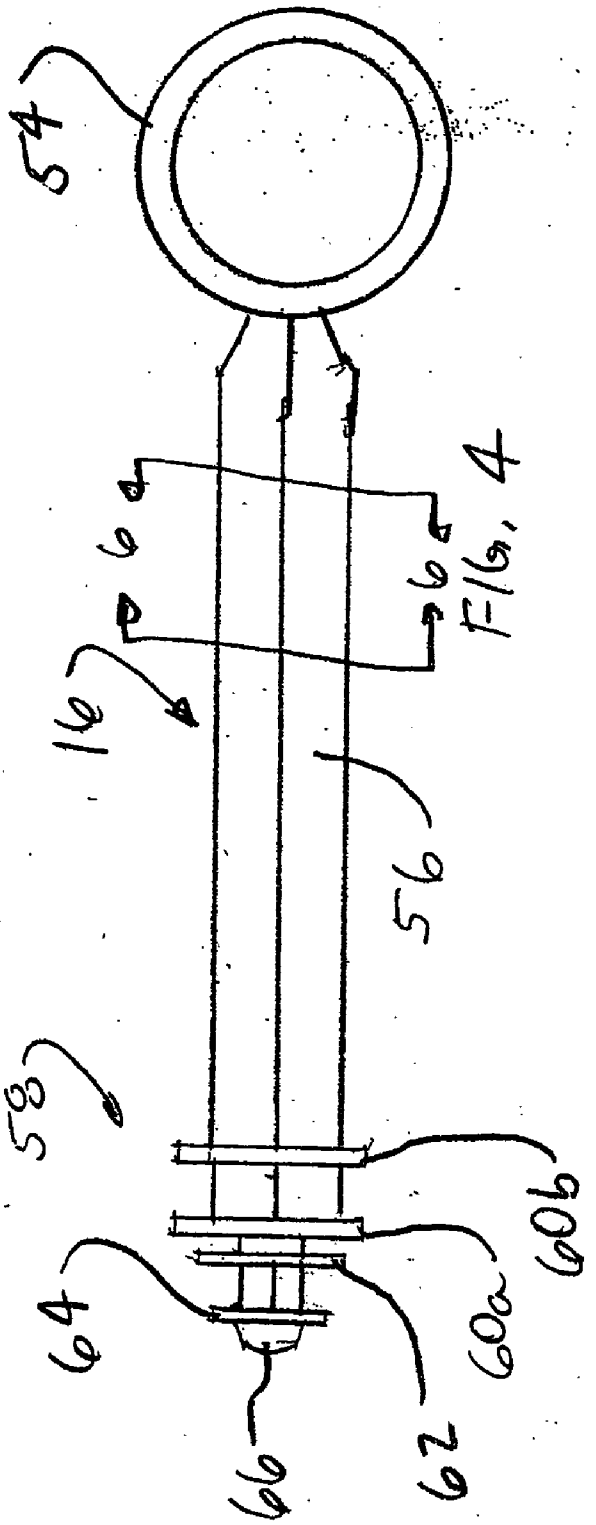


FIG. 4

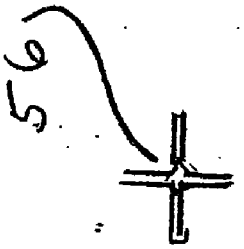


FIG. 6

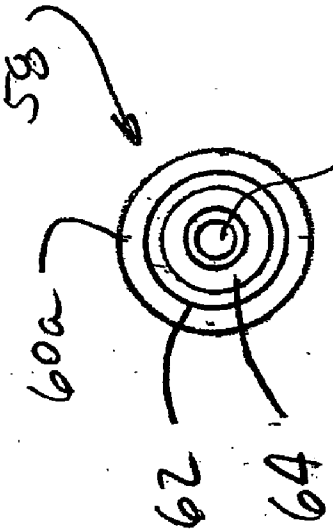


FIG. 5

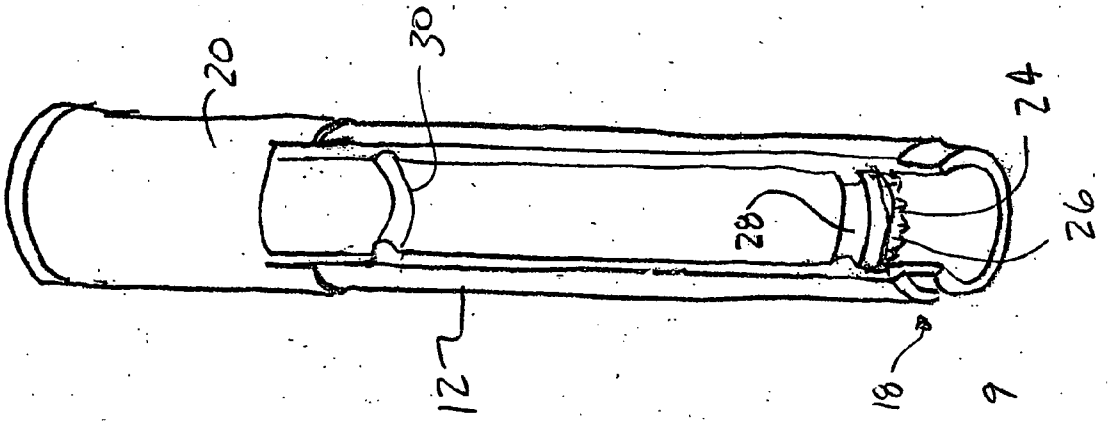


FIG. 9

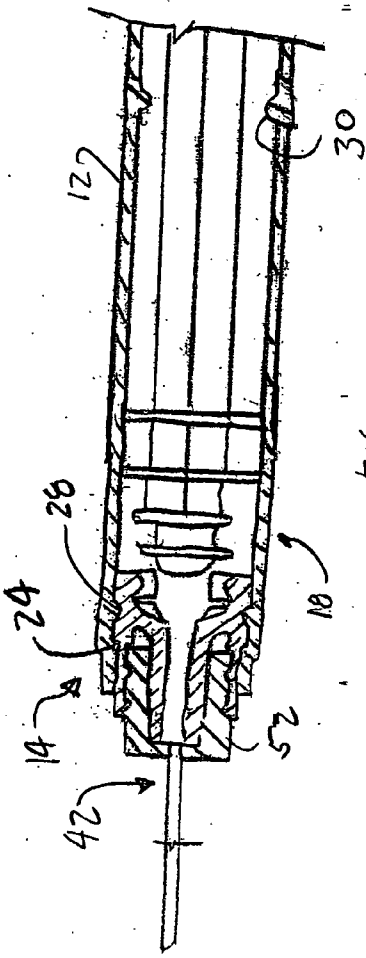


FIG. 7

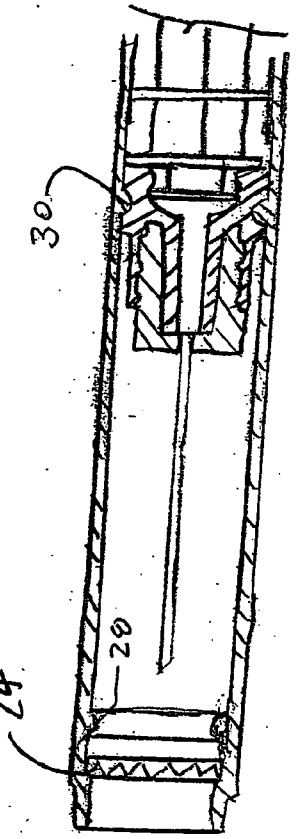


FIG. 8

SAFETY SYRINGE

RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 10/350,961, filed on Jan. 24, 2003, which claims the benefit of U.S. Provisional Application Ser. No. 60/401,742, filed on Aug. 6, 2002, both of which are hereby incorporated herein in their entirety by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to medical devices and more particularly to hypodermic syringes designed to provide cross contamination protection to others by way of a retractable needle assembly that prevents accidental contact with the needle after use.

BACKGROUND OF THE INVENTION

[0003] Inadvertent needle stick injuries form used syringes may present a significant health hazard to others if infectious blood products are transmitted. Such accidental needle sticks may spread hepatitis, AIDS and other communicable diseases to health care workers and patients. In certain instances, the resulting disease may be life threatening. Further, the emotional distress from the fear of contracting such diseases can be significant. Still further, in the event of a stick, series of diagnostic blood tests may have to be performed to determine if cross-contamination has occurred in a needle stick injury. In many cases, the victim often is required to receive injection of gamma globulin to prevent further infection and to cure the patient. This is uncomfortable, inconvenient, and expensive to the victim.

[0004] According to the prior art, the usual technique has been to, after use of the needle, to break off the needle and dispose of the needle and syringe in a "sharps" container for secured disposal such as by incineration or stabilization in, for example, plastic of concrete.

[0005] Efforts have been made to develop syringes which attempt to prevent inadvertent sticks. In Chen, U.S. Pat. No. 6,432,082 issued Aug. 13, 2002, there is disclosed a safety syringe having a needle holder which is retractable into the barrel of the syringe. The needle holder is secured to the syringe barrel by a frangible component. After use, the uses forces the plunger to couple with the needle holder and withdraws the plunger to rupture the frangible component so that the portion of the holder mounting the needle (cannula) can be withdrawn into the barrel. A drawback of this design is that the frangible portion of membrane must be manufactured to tolerances such that (1) the pressure imposed by the plunger during aspiration of the medicine into or injection of the medicine out of the syringe does not rupture the seal and (2) still provide for rupturing the portion during withdrawal of the plunger without the plunger first separating from the needle holder. It is submitted that such requirements contribute to the expense of such a device. Further, the inability of the health card provider to rupture the portion will cause frustration and abandonment of the operation to withdraw the needle.

[0006] In Jenson, U.S. Pat. No. 5,540,660 issued Jul. 30, 1996 there is disclosed another syringe where a needle holder is captured by the plunger for withdrawal into the syringe barrel. In one embodiment of this disclosure, the plunger makes and interference fit into a tapered sleeve such that withdrawal of the plunger withdraws the sleeve and needle into the barrel. A drawback of this arrangement is that it would be difficult to aspirate medicine into the syringe without creating an interference fit between the plunger and sleeve thus disabling the syringe before injection of the medicine. In another embodiment an snap connection is utilized to couple the plunger to a needle holder. In either embodiment, close tolerances must be adhered to during manufacture to provide the seal between the sleeve and needle holder. Further, for either embodiment, an arcuate cannula is required to prevent re-use of the device.

[0007] Mazur, U.S. Pat. 5,205,824 issued Apr. 27, 1993 discloses another syringe where the needle holder is retained at the end of the syringe barrel only by the friction between the o-rings and the barrel which, it is believed, would (1) make secure attachment of the needle to the holder difficult since the holder may tend to rotate as the needle is threaded thereon. Further there remains a risk that insertion of the needle into a bottle of medicine for aspiration of medicine into the syringe would dislodge the needle holder and interfere with the seal.

[0008] There is a need for safety syringe which is easy and inexpensive to manufacture, which provides for withdrawal of the needle into the barrel of the syringe, which can be re-used if desired, which has a positive coupling to provide for attachment of the needle and retention of the needle during aspiration and injection, which provides for a positive stop during withdrawal of the needle to indicate full withdrawal of the needle and which overcomes the drawbacks noted above.

SUMMARY OF THE INVENTION

[0009] There is, therefore, set forth according to the present invention, a safety hypodermic syringe designed to provide cross contamination protection to others by way of a retactable needle assembly obviating accidental contact with the needle to another person and which is of simple and inexpensive construction.

[0010] Toward this end the safety syringe is disclosed which includes a hollow barrel having a forward and rear end. Proximate the forward end a first retention structure is provided which may be in the form of a circumferential groove or ridge or other suitable structure. A first coupling structure is also provided at the first end. Proximate said rear end is a second retention structure which may also be in the form of a circumferential groove or ridge.

[0011] A needle carrier is disposed at said forward end and has a third retention structure configured to engage with the first retention structure to releaseably retain the needle carrier at the forward end and to engage the second retention structure to retain said needle carrier in a position withdrawn into the barrel. To prevent the needle carrier from rotating in the barrel at the first end, the barrel and needle carrier have cooperative coupling structures which may be embodied as engaging tabs or teeth. Also provided is a mounting for mounting a needle such as a threatened or luer lock connection as is known in the art.

[0012] A plunger is disposed in the barrel and has a head to slideably seal within the barrel for aspiration of fluid into an out of the barrel. At the head and at the needle carrier are

cooperative attachment components which, when engaged, attach the needle carrier to the plunger for withdrawal thereof. Withdrawal of the plunger disengages the third retention structure from the first retention structure to release the needle carrier to be withdrawn a position in the barrel where the third retention structure engages the second retention structure to retain the needle carrier with its needle in the withdrawn position.

[0013] The barrel may be rigid but is preferably fashioned from an elastomeric material such as plastic or the like to be radially biased at least in the regions of the first and second retention structures for engagement with the third retention structure. The barrel may also be rigid with an elestomeric liner.

[0014] Accordingly, the health care provider positions the plunger adjacent the needle carrier and secures the needle to the needle carrier. The needle is inserted into a vial of fluid and the plunger is withdrawn to aspirate the fluid to be injected into the barrel. The needle is withdrawn from the vial and, for example, inserted into a patient. The plunger is pushed through the barrel to aspirate the fluid from the barrel through the needle into the patient. At the forward end the plunger is positioned such that the cooperative retention structures on the head and needle carrier engage to capture the needle carrier to the plunger. Thereafter the plunger is withdrawn disengaging the needle carrier from the forward end of the syringe barrel and continued withdrawal of the plunger withdraws the needle carrier and needle to a position nested within the barrel whereat the needle carrier engages the second retention structure to retain the needle carrier within the barrel. In this position the needle is safely withdrawn into the barrel to prevent inadvertent sticks. The syringe may then be disposed of in a sharps disposal container. If desired, the syringe may be sterilized and re-used.

DESCRIPTION OF THE DRAWINGS

[0015] These and other features and advantages will become better understood with reference to the description, claims and drawings wherein:

[0016] **FIG. 1** is a front perspective view of the syringe without a needle;

[0017] **FIG. 2** is a side, perspective, partial section view of the needle carrier;

[0018] **FIG. 3** is a side section view of the needle carrier mounted in the barrel of the syringe of **FIG. 1**;

[0019] **FIG. 4** is a side view of the plunger for the syringe of **FIG. 1**;

[0020] **FIG. 5** is an end view of the plunger of **FIG. 4**;

[0021] **FIG. 6** is a section view of the fluted shaft of the plunger of **FIG. 6** taken along line **6-6**;

[0022] **FIG. 7** is a side section view of the syringe with the plunger in a first position;

[0023] **FIG. 8** is a side section view showing capture of the needle carrier by the plunger and withdrawal into the barrel; and

[0024] **FIG. 9** is a perspective, partial cutaway view of the barrel for the syringe.

DESCRIPTION

[0025] Turning to the drawings, **FIG. 1** shows the safety syringe **10** according to the present invention. The syringe **10** includes a barrel **12** which may be cylindrical and rigid such as by being manufactured from a hard plastic. Alternatively and preferably, the barrel may be constructed from an elastomeric or elastically deformable material such as vinyl, soft polyurethane or other elastically, radially biased, deformable plastic. The deformable plastic should be somewhat elastic but still able to retain its overall cylindrical shape and should be selected to withstand sterilization processes. Still alternatively, the barrel **12** may be rigid with an interior, elastic, lining. Thus, the elastic characteristic permits the barrel **12** to impose a radial bias against expansion and to be contractile to a degree.

[0026] To provide for aspiration of the desired amount of fluid, e.g. medicine, into the barrel **12**, the barrel should transparent or semi-transparent and include graduation markings to indicate volume within the barrel **12**.

[0027] The syringe **10** also includes a needle carrier **14**, the details of which will hereafter be described.

[0028] To provide for aspiration of fluid into an out of the syringe barrel **12**, the syringe **10** includes a plunger **16**, the details of which will hereafter be described.

[0029] The barrel **12** is hollow and preferably cylindrical having a forward end **18** and rear end **20**. At the rear end **20** a pair of finger loops **22***a, b* may be mounted to the barrel **12** to receive the fingers of the health care provider using the syringe **10**.

[0030] With reference to **FIGS. 3**, and **7-9**, the barrel **10** includes proximate the forward end **18** a rearward facing, circumferential should **24** which defines a first coupling structure the purposes of which will hereinafter become evident. The shoulder **24** may have teeth **26**, tabs, notches or other cooperative structure to engage with structure on the needle carrier **14** to prevent coaxial rotation thereof relative to the barrel **12**.

[0031] Disposed rearward of the shoulder **24** inside the barrel **12** is a first retention structure **28** illustrated as one or more circumferentially arranged, radial projections fashioned within the barrel **12**. As shown in the drawings, the first retention structure **28** may be a continuous, circumferential ridge or projection. Alternatively the first retention structure may be discontinuous.

[0032] Disposed proximate the rear end **20** of the barrel **12** and inside thereof is a second retention structure **30**. The second retention structure **30** has a construction similar to the first retention structure **28**. The second retention structure **30** is disposed such that, as hereinafter described, the needle carrier **14** and attached needle can be fully withdrawn into the barrel **12**.

[0033] In an alternative embodiment, the first and second retention structures **28, 30** may be embodied as continuous or discontinuous circumferential grooves in the inside wall of the barrel **12**.

[0034] Turning to **FIGS. 2 and 3**, an embodiment of the needle carrier **14** is shown. The needle carrier **14** is generally cylindrical to be received at the forward end **18** of the barrel **12**. In a cylindrical first portion **32** there is disposed a third

retention structure **34** shown as embodied as a circumferential depression **36** dimensioned to closely receive the first and second retention structures **28**, **30** of the barrel **12** to releasably retain and capture the needle carrier **14** therein. Where the first and second retention structures **28**, **30** are grooves or depressions, the third retention structure **34** would be a projection to be received into the grooves.

[**0035**] The first portion **32** transitions to a smaller diameter second portion **38** at a circumferential, axially and forwardly directed, surface **40** defining a second coupling structure. The surface **40** is cooperatively configured to engage with the first coupling structure of the shoulder **24** and its teeth **26** to couple the needle carrier **14** to the barrel **12** against axial rotation. Thus the surface **40** includes teeth **42** as well. It should be noted that the first and second coupling structures could have any suitable configuration for coupling thereof such as one or more interlocking tabs, pins, or the like.

[**0036**] At the forward end of the needle carrier there is defined a mounting structure suitable for mounting of a needle **42** (**FIGS. 7 and 8**) or cannula. Accordingly the forward end of the needle carrier includes an axially projecting, hollow, nipple **44**. The nipple **44** is supported by a radial substrate **46** which extends to a cylindrical wall **48** which extends axially spaced from the nipple **44**. The inside surface of the wall **48** includes threads **50**. The needle **42** has an exteriorly threaded cap **52** which is received over the nipple **44** and is threaded into the wall **48** with cooperating threads. The cap **52** and threads **50** define a standard luer lock connection for the needle as is known in the art. As shown in **FIG. 7**, when the needle **42** is mounted to the needle carrier **14**, a fluid passageway is defined through the nipple **44** and needle **42** for fluid to be aspirated into and from the syringe barrel **12** through the needle **42**.

[**0037**] Opposite the nipple **44** the needle carrier **14** has a first attachment component **70** adapted for coupling the needle carrier **14** to the plunger **16**. With reference to **FIG. 3**, the first attachment component is defined as an ellipsoidal recess **72** defined in the needle carrier **14** and which intersects with the hollow of the nipple **44**. The recess **72** opens to the inside of the barrel **12** through a reducing neck **74** defined by a circumferential, and radially inwardly directed nose **76**. At spaced locations, e.g. at 90 degrees intervals, radially directed, deformable wings **78** extend into the recess **72**. Each wing includes a radial slot **80**.

[**0038**] To provide for aspiration of fluid and for withdrawing the needle carrier **14**, the syringe **10** also includes the plunger **16** as shown in **FIGS. 4-6**. The plunger **16** includes at one end a thump loop **54** to receive the thumb of the health care provider for manipulation of the plunger **16**. A shaft **56** may be orthogonally fluted or of any other suitable shape.

[**0039**] At the head **58** there are disposed axially spaced and radially extending first and second seals **60***a, b* which are, when the barrel **12** is rigid, elastically deformable to engage and seal against the inside surface of the barrel **12**. Where the barrel **12** is elastomeric or includes an elastomeric lining, the seals **60***a, b* may be rigid.

[**0040**] Forward of the seals **60***a, b*, the head **58** includes a radially extending stop **62**. Forward of the stop **62** is a radially extending, deformably disk **64** of a size to (1) deform to pass through the neck **74** and to expand to engage into the slots **80** for coupling the needle carrier **14** to the plunger **16**. The disk **64** defines a second attachment component for the syringe **10**. Forward of the disk is an end piece **66** which is adapted to be received into the recess **72**.

[**0041**] With the foregoing in the mind the operation of the syringe **10** will now be described. The syringe **10** is assembled with the needle carrier **14** disposed in the forward end **18** of the barrel **12**. In this position the first retention structure of the barrel, e.g. the radially projecting projection, is received into the depression of the needle carrier **14** defining the third retention structure. The elastomeric character of the barrel **12** constricts to retain the components. Thus, to displaced the needle carrier **14**, i.e. disengage the first and third retention structures, and first axial displacement force is required. This force may act to locally expand the barrel **12** or, if the barrel **12** is rigid, compress the first portion **32** of the needle carrier **14** or both. In a preferred embodiment the interference retention of the needle carrier **14** in the barrel **12** is with a force F_1 greater than that required for insertion of the needle into a medicine vial, patient or other intended use. That is, during aspiration, the needle carrier **14** remains retained by the engagement of the first and third retention structures.

[**0042**] As manufactured, the plunger **16** is retained in the barrel **12** for example in the position as suggested in **FIG. 7** in readiness for aspiration of medicine into the syringe **10**.

[**0043**] The needle **42** is threaded onto the needle carrier **14**, also as suggested in **FIG. 7**. The needle carrier **14** is retained against rotation during the mounting of the needle **42** by the coupling between the shoulder teeth **26** and the teeth of the surface **40**. Once the needle **42** is secured to the needle carrier **14**, the needle **42** is inserted into a medicine vial, for example, and the plunger **16** is withdrawn in the barrel **12** to aspirate medicine into the barrel **12**. The seals **60***a, b* seal the plunger head **58** within the barrel **12**. Any air remaining in the barrel **12** is aspirated from the barrel **12** by forward movement of the plunger **16**.

[**0044**] The needle **42** is then inserted into the patient and the medicine is aspirated from the barrel **12** by forward motion of the plunger **16** and injected into the patient. The elastomeric character of the barrel **12** helps seal against the plunger **16**. At the end of the injection, the plunger **16** is displaced to cause the head **58** to approach the needle carrier **14**. The disk **64** deforms to pass through the neck **47** and ultimately snap outward to engage into the slots **80** of the wings **78** to thereby attach the needle carrier **14** to the plunger **16** as shown in **FIG. 8**. The stop **63** engages the needle carrier **14** to limit and guide the insertion of the head **58** components into the recess **72**. The plunger **16** may then be withdrawn with a force greater than F_1 to overcome the retention force offered by the engagement by first and third retention structures **28**, **32** to dislodge the needle carrier **14** for withdrawal into the barrel **12**. Continued withdrawal of the plunger **16** pulls the needle carrier **14** into the barrel **12**. When the second retention structure **30** is engaged by the third retention structured **34** of the needle carrier **14**, the needle carrier **14** is retained within the barrel **12**. With the needle carrier **14** in the withdrawn position, the needle **42** is nested within the barrel **12** from the open forward end **18** preventing inadvertent sticks by the needle **42**.

[0045] As can be appreciated, the force F_2 necessary to separate the plunger from the needle carrier **14** must be greater than F_1 in order for the plunger to withdraw the needle carrier **14**.

[0046] To re-use the syringe, it would be sterilized by suitable means such as an autoclave (steam or suitable gas) and the plunger would be re-positioned to locate the needle carrier **14** such that the first and third retention structures engage as do the teeth **26** and **43**. The needle **42** is removed. The needle holder nipple **44** is held while the plunger is withdrawn with a force sufficient to overcome force F_2 thereby releasing the plunger **16** from the needle carrier **14** for re-use thereof.

[0047] It should be noted that the present invention is subject to many modifications without departing from scope of the invention as expressed in the claims. For example, the barrel **12** need not be cylindrical. Further, only a portion of the barrel **12** may be elastromeric or coated with an elastomeric liner.

I claim:

1. A safety syringe comprising:

a hollow barrel having a forward and rear end, said barrel including proximate the forward end a first retention structure and a first coupling structure and proximate said rear end a second retention structure;

a needle carrier disposed at said forward end and including (i) a third retention structure engaging the first retention structure to releaseably retain the needle carrier at said forward end and to engage the second coupling structure to retain said needle carrier in the barrel, (ii) a second coupling structure to engage the first coupling structure to prevent rotation of the needle carrier at said forward end, (iii) a mounting for mounting a needle and (iv) a first attachment component disposed opposite said mounting; and

a plunger having a head to slideably seal within the barrel for aspiration of fluid into an out of the barrel and a second attachment component to engage the first attachment component of the needle carrier to attach the needle carrier to said head, withdrawal of the plunger disengaging the third retention structure from the first retention structure to release the needle carrier and needle to be withdrawn a position in the barrel where the third retention structure engages the second retention structure to retain the needle carrier and needle in the withdrawn position.

2. The safety syringe of claim 1 comprising said first and second retention structures include radial projections in said barrel and said third retention structure includes a cooperative radial depression in said needle carrier to receive said projections.

3. The safety syringe of claim 2 comprising said first and second retention structures include radially projecting ridges and said third retention structure includes a radial groove in said needle carrier.

4. The safety syringe of claim 1 comprising said first and second retention structures include grooves in said barrel and said third retention structure includes a radial protuberance to engage into said grooves.

5. The safety syringe of claim 1 comprising said barrel is constructed from an elastomeric material.

6. The safety syringe of claim 1 comprising said first and second attachment components includes a deformable tab snap-engaging a cooperative recess.

7. The safety syringe of claim 1 comprising said mounting is a luer lock mounting.

8. The syringe of claim 1 comprising said first and third retention structures cooperating to release the needle carrier at a first withdrawal force and said second and third retention structures cooperating to release the needle carrier at a greater, second withdrawal force.

9. A safety syringe comprising:

a hollow cylindrical barrel having a forward and rear end, said barrel including proximate the forward end a first radial projection and a first coupling structure and proximate said rear end a second radial projection;

a needle carrier disposed at said forward end and including (i) a depression to receive the first projection to releaseably retain the needle carrier at said forward end and to receive the second projection to retain said needle carrier in the barrel, (ii) a second coupling structure to engage the first coupling structure to prevent rotation of the needle carrier at said forward end, (iii) a mounting for mounting a needle and (iv) a first attachment component disposed opposite said mounting; and

a plunger having a head to slideably seal within the barrel for aspiration of fluid into an out of the barrel and a second attachment component to engage the first attachment component of the needle carrier to attach the needle carrier to said head, withdrawal of the plunger disengaging the third retention structure from the first retention structure to release the needle carrier and needle to be withdrawn a position in the barrel where the third retention structure engages the second retention structure to retain the needle carrier and needle in the withdrawn position.

10. A safety syringe comprising:

a hollow barrel having a forward and rear end, said barrel including proximate the forward end a first groove and a first coupling structure and proximate said rear end a second groove;

a needle carrier disposed at said forward end and including (i) a protuberance to engage into the first groove to releaseably retain the needle carrier at said forward end and to engage into the second groove to retain said needle carrier in the barrel, (ii) a second coupling structure to engage the first coupling structure to prevent rotation of the needle carrier at said forward end, (iii) a mounting for mounting a needle and (iv) a first attachment component disposed opposite said mounting; and

a plunger having a head to slideably seal within the barrel for aspiration of fluid into an out of the barrel and a second attachment component to engage the first attachment component of the needle carrier to attach the needle carrier to said head, withdrawal of the plunger disengaging the third retention structure from the first retention structure to release the needle carrier and needle to be withdrawn a position in the barrel where the third retention structure engages the second retention structure to retain the needle carrier and needle in the withdrawn position.

* * * * *