FUTURISTIC SAFE INJECTION SYSTEM-2020


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Video available on YouTube link:
https://www.youtube.com/watch?v=wIPlYyoJCWY
INNOVATION

Abstract of innovation:

WHO is waging full scale war, literally a crusade, for last two decades against alarming menace of unsafe injections resulting accelerating dreadful and frightening diseases i.e. 21 million Hepatitis B, 2 million Hepatitis C, 260 000 HIV/AIDS infections, 1.3 million early deaths, a loss of 26 million years of life and a direct medical costs of 535 millions of US dollars, as reported by WHO*. The needle stick injuries (NSI) and rapidly growing hazardous biomedical waste is also a matter of concern which claims more than 30 million lives every year worldwide with unexpected increase in global healthcare burden (GHB), as estimated $1 billion alone in USA. The syringe industry worth $26 billion annual business turnover including all major R&D institutions is seriously putting herculean efforts to design safe retractable syringe compatible to WHO guidelines. We are engaged in designing low cost safe retractable syringe. How is it possible to implant any retraction mechanism in syringe without increasing its cost? The retraction technology may never be affordable to all. We need to think out of box to tackle this dreadful menace. Our invention, recently published by WIPO, consists of a reusable injector and safely disposable drug cartridge, wherein fixed dose of injectable drug is sandwiched between a piston head and retractable needle. Neither of the two parts per se are syringe but constitute self-retractable safety syringe when coupled together, operable like an ordinary conventional syringe. As soon as the injection process completes, needle retracts automatically within the empty cartridge, which may be safely disposed-off. The injector bearing the retraction mechanism may be used frequently for long period to decrease the over-all cost of injection process at least upto 85-90%. The disposable drug cartridge, thus, constitutes a smart packaging material to pharmaceutical industry. The injector is also provided with illumination system, which not only regulates and keeps vigil on the injection process but also illuminates the injection site in dark hours. Besides, the injector may also be attached with the specially designed Fluid Collector constituting a safe fluid collecting system, which can be effectively utilized to safely collect the fluid samples. The European Patent Office, while examining our International Patent Application (PCT/IB2016/051060) WO/2016/142799 A FLUID INJECTING SYSTEM WITH NEEDLE RETRACTION BY VACUUM, has opined, “The technical effect of these features is that the injector is reusable while the only parts to be discarded are the needle hub and the medicament cartridge. As a result a cheaper and friendlier to the environment system is achieved without an increased risk of needle injuries.”

Our invention effectively addresses WHO’s Global Healthcare Concerns by providing a most effective, cheapest, safer, greener and user-friendlier substitute of conventional syringe compatible to WHO’s guidelines. The proposed method & device will effectively reduce the Needle Stick Injury (NSI) almost to zero. It will dramatically reduce the hazardous biomedical waste generated due to disposable syringes by 70-75% and save the same extent (70-75%) of raw material. It generates only 25-30% non-hazardous (safe) bio-medical waste, which may safely be recycled without any risk of NSI and least probability of being reused. Besides, it may also effectively address the menace of counterfeit injectable medicines and illicit drug abuse. It is expected to reduce the environment footprint of syringe industry to
high extent with significant decrease in overall Global Healthcare Burden (GHB) as well as Global Disease Burden (GDB). Being most effective and cheapest substitute to safety syringes, it will not only promote, democratize and make the healthcare equally affordable and accessible but also bridge the technology divide between developed and developing/under-developed countries.

**Unique feature of innovation:**

1. It provides a smart packaging technology to pharmaceuticals to pack injectable drugs in drug-cartridge dose-wise. The drug-cartridge is designed in such a manner that it may not be refilled and eliminates all the possibility of NSI.
2. It adapts and utilizes the drug container conventionally used by pharmaceutical industry to store the injectable medicine i.e. vile, ampoules etc. as a barrel of syringe.
3. It adapts the vital and costly retraction mechanism to make it an integral part of frequently reusable injector, which ultimately reduces the over-all cost of whole injection process at least upto 85-90%.
4. Neither the disposable drug-cartridge nor the reusable Injector *per se* is syringe but an efficient self-retractable safety syringe is constituted when both parts are coupled together. This syringe is operable like an ordinary conventional syringe without any requirement of special training to the user or healthcare worker.
5. The injector is provided with an illumination system to illuminate the injection site visible in dark hours. It serves as indicator to regulate and keep vigil on the entire injection process.
6. Our invention also provides a specially designed fluid collector which may be coupled with the reusable injector to collect the sample fluids safely without any risk of needle stick injury for pathological/examination purposes.

**The problem that our innovation has addressed:**

There is a high rise in use of injection in last two decades. Presently, 16 billion injections are consumed worldwide per year. WHO reports (2000) suggests that over 70% of injections are unnecessary in some regions. Up to 70% of injections are given with reused syringes and needles in developing countries. They are leading to 21 million cases of Hepatitis B, 2 million cases of Hepatitis C and 260,000 HIV/AIDS infections annually worldwide. The developing and underdeveloped countries are worst hit by this menace, particularly needle stick injuries (NSI). Overall 1.3 million early deaths occur causing a loss of 26 million years of life every year worldwide with unexpected increase in global healthcare burden (GHB), as estimated $1 billion alone in USA. Increasing Global Disease Burden (GDB) promotes the growth of injections and when constituted with increasing incidence of diseases like Diabetes, it is leading to ever-growing piles of hazardous biomedical-waste, thus resulting in a vicious cycle. This not only creates a serious health concern but also increases global carbon footprint of syringe industry contributing to climate change. Although there exist many types of safety syringes but they are neither affordable nor accessible, and nor completely eliminate the ills of conventional syringes.

Our Futuristic Safe Injection System most efficiently as well as effectively addresses the above-mentioned dreadful menace in following manners:

1. It provides a green, safer, cheapest and user-friendly substitute of conventional safe syringes possessing all essential safety features of an efficient retractable syringe.
2. It will effectively decrease the cost of conventional injection system up to 85-90%
3. It will eliminate all probabilities of contamination which occur during transfer of drug-contents from conventional drug-container to syringe. It will also prevent unnecessary wastage of approximately 40% costly medicines, which remains unused in large container of 5-10 ml and is discarded.
4. It will eliminate all the probabilities of under-dosage/over-dosage administration of medicine as drug-cartridge shall contain pre-fixed dosage of medicine which shall be completely delivered into the patient without any kind of user-interference.
5. The illumination of indicator during the injection process not only confirms the completion of injection process, but keeps an effective vigil and surveillance and creates awareness of handling the patients by healthcare workers. It shall also facilitate administration of drug during dark hours.
6. The packaging of drug into proposed drug-cart shall improve the efficacy of drug to a considerable extent which is diminished on account of the undesirable chemical reactions between the stored drug contents for long and the gases i.e. oxygen and nitrogen present in entrapped air. This feature ensures to maintain the original efficacy of drug and shall completely eliminate the probability of entrapped air bubble.
7. It will ensure reduction of weight and volume of syringe per dose carried by health workers in work-field and will also reduce the burden of care on them as they require carrying only the desired quantity of drug-carts and a pen-type injector in the field.
8. It will completely eliminate of need of additional syringe for drug administration, saving of entire raw material and manufacturing cost of syringe. It shall ultimately decrease exorbitant GHB to a maximum extent.
9. It will curtail and avoid generation of 70-75% of hazardous bio-medical waste and create only 25-30% of safe bio-waste.
10. It will eliminate all probabilities of reuse of used/discarded syringes by making manufacturing cheaper than reuse.
11. It will prevent physical, mental, emotional and psychological trauma by preventing NSI causing spread of HIV, Hepatitis B,C etc. popularly known STDs, that are social taboo.
12. The complete elimination of syringes will ensure prevention of abuse of injectable drug.

Proposed impact of our innovation:

Our Futuristic Injection System will democratize the healthcare system to make it equally affordable and accessible to all by providing a green, safer, cheapest and user-friendly method and device for drug delivery system. This will result in almost 100% achievement of WHO’s target by completely replacing the conventional syringe with our safety syringe by 2020. It will also help in meeting Sustainable Development Goals by multi-fold benefits to the healthcare system. It will also help us in meeting INDCs and face the challenges of Climate-Change by completely negating the global carbon footprint of syringe industry. The highest goal of securing a safe and dignified ‘Right to Life for all’ for the welfare of mankind may finally be achieved by using our ‘Futuristic Injection System-2020’.

Green and Sustainable aspects of our innovation:

1. Our invention provides a green, safer, cheapest and user-friendly substitute of conventional safe syringe, having no requirement of special training to healthcare
workers for its operation. This makes it equally affordable and easily accessible to all without any technological divide between poor and riches.

2. As the costly retraction mechanism containing injector is frequently reusable, it will reduce the cost of injection process approximately 85-90% in comparison to conventional process because it eliminates the requirement of separate syringe, thus directly whittle-down the burden of buying syringe for each and every dose on the pocket of end-user.

3. This will save 70-75% of raw material as well as entire manufacturing cost of syringe. It will automatically reduce the overall volume of disposable bio-medical waste, as the only empty drug-cartridge is disposable.

4. The expenses incurred on the packaging, storage, transport, carriage etc. shall be reduced to a high extent, which shall ultimately decrease exorbitant burden on GHB to a maximum extent leading to lots of financial saving which can be used for improving healthcare facilities for better living conditions.

5. The smart packaging of dosage of injectable drug will prevent the unnecessary wastage of costly drug in two ways: (i) the drug contents go waste during its transfer from drug container to the syringe. (ii) Sometimes, the drug container contains 5-10 dosage but only few dosage are utilized and the rest is discarded. This will increase the availability of drugs to more people. It will also increase efficacy of drug for a long time by preventing any possibility of contamination. It will also eliminate need of separate packaging material i.e. ampules, vials or the like containers to preserve, store and supply of drug.

For more detail, please click the following video link:
https://www.youtube.com/watch?v=wIPlYyoJCWY
PROBLEM

Overuse of injections and unsafe injection practices worldwide in 2000

- Injections worldwide - 16 billion/year
- 6.6 billion (39.6%) were given with reused equipment
- Upto 70% of injections are given with reused syringes and needles in the developing world
- Over 70% of injections are unnecessary in some regions

Infections due to unsafe injections worldwide in 2000
Unsafe injection practices, annually cause:

- 21 million hepatitis B infections (30% of new cases)
- 2 million hepatitis C infections (41% of new cases)
- 260 000 HIV/AIDS infections (9% of new cases)
- 1.3 million early deaths, a loss of 26 million years of life, and direct medical costs of 535 million US dollars.

www.who.int/medical_devices/Sun_pm_SAF_2_ALLEGRA.pdf
SOLUTION OF THE PROBLEM

TO ELIMINATE THE CONVENTIONAL SYRINGE SYSTEM TO DECREASE GHB & BIO-MEDICAL WASTE

REUSABLE INJECTOR
(Reusable frequently for unlimited number of injections)

CONVENTIONAL SYRINGE SYSTEM
(Ordinary/Auto-disable or Retractable)
COMPLETELY DISCARDED AFTER USE
(Bio-medical waste 100% by volume)

DRUG-CARTRIDGE
DISCARDED AFTER USE
(Bio-medical waste 25-30% by volume)

* Global Healthcare Burden
** Retraction Mechanism/Auto-disable features
CONSTITUTION OF SELF-RETRACTABLE SYRINGE

**INJECTOR**
(Injector with Forcep-head shaft)

**DRUG-CARTRIDGES (DRUGCARTS)**
(three variants of Drugcarts)

(a) Drugcart (DC) with Needle (where needle is required to be drawn by the user)

(b) Drugcart with Needle (where needle comes out automatically during injection process).

(c) Drugcart without Needle (where desired needle may be attached)

**OPERATIONAL STEPS**

1. Injector and Drug-Cart

2. Injector attached with Drug-Cart (DC) to constitute Self-retractable Syringe
3. The Needle Guard is drawn out by user, the Needle assembly clicks fit with Needle hub. The Needle guard is rotated anticlockwise by 90 degree angle and drawn to separate from needle. The Needle exposes.

4. The Outer plunger is pulled out completely like a usual piston of ordinary syringe. The proximal end of outer barrel clicks fit with U-chip lock. A vacuum (V) is generated between inner & outer Plunger barrels. Assembly becomes ready for drug delivery.

5. The bulb glows and illuminates the end-tip of needle and surrounding area of body part to facilitate injection in dark. The needle is pricked in body for injection.

6. On pushing the plunger in forward direction through Thumb rest, the proximal end of Forceps head locks with the distal cavity of piston assembly of DC and constitutes a single plunger unit consisting of inner and outer plunger barrel plus piston assembly of DC.

7. The user may now operate on the device in usual manner, as if it is ordinary syringe. The Needle is now pricked in body for drug delivery process.

8. The drug is injected in body by pushing the ‘single plunger unit’ in forward direction with the help of Thumb rest.
9. Just before the completion of drug delivery process, the proximal-end of the teeth of circular cutter come in contact of diaphragm of the needle hub and cut the diaphragm to separate the needle hub from the needle assembly.

10. As soon as the Injection process is complete, the following functions take place simultaneously:

(a) The needle hub is cut separated from the needle assembly and fixedly attached to the piston assembly through the furrowed knob.

(b) The U-clip lock of injector operates automatically and facilitates the retraction of the inner plunger assembly along with all parts including piston assembly and needle due to reduced pressure of vacuum already created between inner and outer Plunger-barrels.

(c) Inner plunger barrel now comes at rest/in initial state and the forecep lock head is automatically detached from the cavity of piston assembly of empty DC.

Now the injection process is complete. As soon as the injection process completes, the glowing bulb off, indicating completion of process.

11.

12.

13. Now, needle cover may be inserted in the empty drug cart for further protection from used needle already encapsulated in the empty DC. Empty DC is detached from the Injector and Injector becomes ready for further operation.

Piston assembly with piston seal, needle catch projection (axially furrowed knob) and saw-tooth
COLLECTION OF FLUID FROM BODY

1. INJECTOR
2. FC fitted with injector
3. Seal removed
4. Vacuum
   Plunger pulled to create vacuum in the Injector.
   The bulb glows
Needle cap removed

Needle pricked & embedded in fluid source

Piston pushed completely, which results in closing the lock of injector resulting inner barrel sliding in backward direction along with the piston seal of FC, it results in sucking the fluid from the fluid source.

When the flaps pass through the diaphragm septum, the forcep headed lock is closed being pressed inwardly resulting detachment of forcep head from the outer conical cavity of seal of FC. Thus fixed volume of fluid is stored in FC.
Inner plunger barrel reaches at initial state and the glowing bulb off indicating the completion of process. Needle is capped with needle cover.

FC containing fluid is detached from Injector and mat be transported for intended purpose.

Fig. 14, 15 & 16 show how to work with collected fluid conveniently. The FC containing fluid content is again attached with Injector (Fig. 14) and when needle cap is removed, the needle itself is detached from FC, becomes non-reusable and remains safely inside the needle cover.

If required, fresh needle may be attached with FC.

The whole process of pulling & pushing may be repeated to eject the required amount of fluid from FC.

When fluid is completely used, the fore head of FC is covered and the empty FC is safely disposed off.
REDUCTION OF BIOMEDICAL WASTE AND SAVING OF RAW MATERIAL (by volume)

Drug delivery by Conventional syringe

<table>
<thead>
<tr>
<th>Bio-waste Generated</th>
<th>Reusable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syringe and Drug container (100%)</td>
<td>None</td>
</tr>
<tr>
<td>Used Syringe and Drug container (100% by volume)</td>
<td></td>
</tr>
</tbody>
</table>

Drug delivery by Proposed method & device

<table>
<thead>
<tr>
<th>Bio-waste Generated</th>
<th>Reusable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injector and Drug-cartridge (100%)</td>
<td></td>
</tr>
<tr>
<td>Empty Drug-cartridge (25-30% by volume)</td>
<td>Reusable Injector (70-75% by volume)</td>
</tr>
</tbody>
</table>
**DISTINGUISHING FEATURES OF PROPOSED SYSTEM**

Comparison with Conventional Syringes

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>FEATURES</th>
<th>CONVENTIONAL SYRINGES</th>
<th>PROPOSED METHOD &amp; DEVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sterilisable Syringes</td>
<td>Disposable syringes</td>
</tr>
<tr>
<td>1.</td>
<td>Risk of Needle Stick Injury</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>2.</td>
<td>Risk of failure of AD/RM features</td>
<td>---</td>
<td>----</td>
</tr>
<tr>
<td>3.</td>
<td>Risk of under/over dosage</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>4.</td>
<td>Unnecessary Wastage of medicine</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.</td>
<td>Risk of contamination of Medicine</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>6.</td>
<td>Ease of injection process</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>7.</td>
<td>Frequency of Injection process</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>8.</td>
<td>Indicator to monitor injection process</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>9.</td>
<td>Illumination of injection area in dark</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>10.</td>
<td>Generation of Biomedical waste</td>
<td>100% by volume</td>
<td>100% by volume</td>
</tr>
<tr>
<td>11.</td>
<td>Economic burden on end-user</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>12.</td>
<td>Manufacturing, storage, transport, care costs etc.</td>
<td>High</td>
<td>low</td>
</tr>
<tr>
<td>13.</td>
<td>Care, carriage etc. Burden on healthcare worker</td>
<td>High</td>
<td>low</td>
</tr>
<tr>
<td>14.</td>
<td>Risk of Air-embolism</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
COMPLIANCE OF INTERNATIONAL REGULATORY GUIDELINES

**Completely NIOSH complaint system**

National Institute for Occupational Safety and Health (NIOSH, 1999) has laid down Safety feature characteristics for evaluating and selecting needle-stick injury prevention products which include:
- The safety feature is an integral part of the injector.
- The device preferably works passively (requires no activation by the user). If user activation is necessary, the safety feature can be engaged with a single-handed technique and allows the worker’s hands to remain behind the exposed sharp.
- The user can easily tell whether the safety feature is activated.
- The safety feature cannot be deactivated and remains protective through disposal.
- The device performs reliably.
- The device is easy to use and practical.
- The device is safe and effective for patient care.

**Additional Features**

- Indicator provided in injector to monitor the injection process
- Illumination of the injection area in dark

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**Fully compliant to FDA**

The Food and Drug Administration (FDA) is responsible for clearing medical devices for marketing in the US. It recommends safer needle devices with a fixed safety feature that:
- Provides a barrier between the hands and the needle after use; the safety feature should allow or require the worker's hands to remain behind the needle at all times.
- Is an integral part of the device and not an accessory.
- Is in effect before disassembly and remains in effect after disposal to protect users and trash handlers, and for environmental safety.
- Is as simple as possible, and requires little or no training to use effectively.
Fully compliant to WHO recommendations

Guiding principles to ensure injection device security” (4) issued by SIGN in 2003, which states: “Syringes with a reuse prevention feature offer the highest level of safety for injection recipients. They should be considered for use for therapeutic injections where local data indicate that unsafe practices are particularly common.”

The Guideline Development Group (GDG) of WHO made the following recommendations:

1. “We recommend the use of injection devices with sharps injury protection feature (SIPs), as opposed to devices without a sharps injury protection feature, by health-care workers delivering intramuscular, subcutaneous or intradermal injectable medications to patients (Conditional recommendation, moderate quality evidence)

2. “We recommend the use of injection devices with a reuse prevention feature (RUPs), as opposed to devices without reuse prevention features, by health-care workers delivering intramuscular, subcutaneous or intradermal injectable medications to patients (Conditional recommendation, very low quality evidence)
Page 1

**Title:** A FLUID INJECTING SYSTEM AND A METHOD THEREOF

**Abstract:** A fluid injecting system (100) comprising an injector (A) having an injector body (10), a plunger shaft (30), a plunger assembly (20) having an inner plunger barrel (21) slideable within an outer plunger barrel (22), a fluid-cartridge (B) having afluid (53) and a hypodermic needle (72) for injecting the fluid (53) at an injectable site. The fluid-cartridge (B) is configured to releasably engage with the injector (A). A vacuum (V) is created between the outer plunger barrel (22) and the inner plunger barrel (21) upon formation of a united plunger barrel (40). Also, forward movement of the united plunger barrel (40) transfers the fluid (53) from the fluid-cartridge (B) into the injectable site. The hypodermic needle (72) retracts within empty fluid-cartridge (B) due to re-release of the vacuum (V) and the injector (A) is disengaged from the fluid-cartridge (B) for reuse. Further, a fluid injecting method (300) is provided.

**FIG. 1**

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**OUR INTERNATIONAL PATENT APPLICATION**

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without international search report and so to be republished upon receipt of that report (Rule 48.2(g)).
FIELD OF THE INVENTION

Embodiments of the present invention relate to hypodermic syringes and more particularly to a fluid injecting system and a method thereof. Further, the fluid injecting system is having an injector and a fluid-cartridge. Also, the system prevents from needle stick injuries and is economical and user friendly.

BACKGROUND OF THE INVENTION

Hypodermic syringes having retractable needles are well-known in the art. These syringes are commonly used in healthcare industry to inject therapeutics below the skin of patients. Despite their utility, the hypodermic syringes pose significant safety risks to medical professionals, patients, children playing in a park, street walkers and anyone who could accidentally be pricked by exposed needle of the hypodermic syringe. After disposal, needle stick injuries resulting from contact with discarded needles are an increasing problem. The needle-stick injury is a percutaneous wound typically set by a needle-point before and after use. These events of occupational health hazards are of great concern because of the risk of transmitting blood-borne diseases through passage of hepatitis B virus (HBV), hepatitis C virus (HCV), Human Immunodeficiency Virus (HIV) and the like. Disposal of bio-medical waste also poses a large public health concern. As a result of the foregoing concerns, the safe fluid injecting systems are gaining more and more attention to avoid dangerous needle prick injuries.

Generally, an injectable drug (the fluid) is stored, packed and supplied conveniently by pharmaceutical industries in vials, ampoules and the like containers, which need hypodermic syringes to inject it into the body of human beings or animals. In conventional syringes, an operator first transfers a required volume of the drug into an empty hypodermic syringe by aspiration through the needle before injecting into the patient's body. In case of retractable syringes, a retraction mechanism operable on spring or a similar biasing means is activated to retract the needle into the barrel. After completion of an injection process, the empty vials, ampoules or container, the used hypodermic syringe along with their packaging material etc., which is generally made of non-biodegradable plastic, is finally disposed-off as bio-medical waste, adversely poses a considerable economic as well as environmental burden.
It is also important to note that the injectable drug packed by pharmaceutical industries is never filled into such containers up to the brim but approximately 20-40% volume of air always remains available in direct contact with packed drug during the entire course of storage. The oxygen, nitrogen and other active molecules present in such entrapped air also keep on interacting continuously with the molecules of drug contents, consequently a negative impact on the drug contents leading to ultimate decrease in the efficacy of drug may not be completely ruled out. On the other hand, before aspirating drug content into an empty syringe, the user first injects a current of air through hypodermic needle of empty syringe into such container in order to increase the pressure of air on the drug content, so that it may easily be aspirated into empty syringe by application of negative pressure. The air current forcibly injected into the drug may not be ruled out to contain harmful bio-active molecules or other pollutants except the normal ingredients of air like nitrogen, oxygen, carbon-di-oxide etc. The forceful current of such contaminated air pressed into injectable drug contents increases the probability of chemical interaction between such air and the drug contents to maximum extent due to dissolution of a considerable amount of air contents into drug contents at such high pressure. Under such circumstances, the adverse effect on the potency and efficacy of drug may also not be ruled out. Besides, such current of air passed into the drug contents at such higher pressure is also bound to generate millions of bubbles/micro-bubbles of entrapped polluted air, which are aspirated into the empty syringe. The user may, however, take care of visible bubbles of air but he may never avoid the millions of micro-bubbles entering directly into the blood stream of patient and posing adverse/undesirable impact on patient. We, however, could not find any discussions/literature on these issues, but these issues may not be neglected and need be effectively addressed. We strongly advocate that the injectable drug contents should never come in contact of air contents at any time and the drug need be injected directly into the patient without its being transferred into any other container like empty syringe, so that the potency of drug contents may be maintained and guarded zealously, right from the stage of manufacturing up to its administration into the patient's body.

There have been a number of solutions provided for efficient hypodermic syringes with retractable needles and few of them have been discussed below:
US20060264840A1 describes a retractable needle safety syringe. The syringe comprises a syringe body, a syringe cavity, a plunger, a variable vacuum compartment, a shaft brake, and a ram member. The plunger assembly includes a plunger shaft and a piston slidably engaged within the syringe body. The variable vacuum compartment being operative to provide a vacuum force on the plunger shaft directed from a bottom syringe body end toward a top syringe body end. The shaft brake being operative to frictionally engage the plunger shaft to provide first and second frictional forces in opposition to the vacuum force, the first frictional force being exerted prior to the piston reaching the bottom syringe body end, the second frictional force being exerted in response to the engagement of the ram member with the shaft brake. Further, the second frictional force is less than the first frictional force.

US6712787B1 describes a retractable safety syringe. The retractable safety syringe retracts a needle cannula into a plunger module and thus prevents reuse or an accidental needle prick by destroying a plunger barrier and a cannula barrier within the syringe. Further, the needle cannula is released into the plunger module by shearing the cannula barrier and the plunger barrier with an internal annular shear and cutter head.

US9097435B2 describes a retractable needle fluid transfer device. The device includes a manually operable actuator. Upon depressing the actuator, a spring displaces a needle rearwardly to enclose a contaminated needle. The device includes forward and rearward stops for impeding displacement of the needle after the needle is retracted. A safety sampling access port adapter for obtaining fluid samples from a fluid line is also disclosed. The sampling adapter includes a collapsible socket configured to cooperate with a fluid container such as a vacuum tube. Further, a needle assembly is provided to pierce a seal on the fluid container. After use, the socket is collapsed to prevent contact with the contaminated needle.

The aforesaid documents and other similar solutions may strive to provide efficient hypodermic syringes with retractable needles; however, they still have a
number of limitations and shortcomings such as, but not limited to, relatively low reliability and relatively high complexity as well as relatively high manufacturing cost. Another disadvantage of these hypodermic syringes is the inability to evacuate the entire contents of the injectable drug from cavity. Further, these syringes are not economically feasible because incorporation of a needle retraction mechanism (NRM) in the hypodermic syringes enhances overall cost of the hypodermic syringes to such a greater extent that they become beyond reach of general masses. Furthermore, the operation of safety features is not self-evident and therefore additional training is required to use the hypodermic syringes effectively. Also, the existing hypodermic syringes require exertion of additional force to activate the needle retraction mechanism after the injection process, which ultimately becomes optional to the operator. The forceful activation of the needle retraction mechanism also leads to back stroke and becomes painful for the patient as well as the healthcare practitioners. As a result of the back stroke, the needle shakes and damages tissues which may result in bleeding and abscess may also occur due to the tissue injury.

In addition, the existing hypodermic syringes include a needle which is retracted into a barrel under action of a spring after the injection process. However, in such kind of the hypodermic syringes, the needle is retracted too fast which may result in bursting out of blood under body pressure from punctured hole on the body, which further brings secondary cross infections. The conventional hypodermic syringes also lack full-proof locking arrangement as well as effective retraction mechanism to prevent and restrict further use of the hypodermic syringes once used. Also, these hypodermic syringes do not include a fluid collecting device for collecting a fluid.

In order to effectively address the existing problems and shortcomings, there remains a constant need in the art for an efficient fluid injecting system and a method thereof, for safely injecting a fluid without any risk of needle stick injury. Further, we need such a fluid injecting system capable of not merely retracting the hypodermic needle following its use, but also capable of capturing and firmly retaining the used hypodermic needle in the retracted position within the system rendering it non-reusable.
The proposed fluid injecting system not only addresses all such known alarming issues effectively, but also provides a clean, green, cheap, user-friendly and reliable technological advancement over the known alternatives.

OBJECT OF THE INVENTION

An object of the present invention is to provide a fluid injecting system having an injector and a fluid-cartridge.

Another object of the present invention is to provide a fluid injecting system having an injector and a fluid collector.

Another object of the present invention is to provide the fluid-cartridge to replace the conventional packaging drug containers i.e. vials, ampoules and the like containers, conventionally used by pharmaceutical industries to pack and store the injectable fluid.

Another object of the present invention is to make the fluid-cartridge an integral part of the fluid injecting system by using it to replace the barrel of the conventional syringe.

Another object of the present invention is to provide the fluid-cartridge, which comprises of pre-defined volume of fluid.

Another object of the present invention is to provide the fluid-cartridge having retractable needle assembly either containing inbuilt or replaceable hypodermic needle or has provision to attach the hypodermic needle of desired dimensions.

Another object of the present invention is to provide the fluid-cartridge, wherein inbuilt hypodermic needle is either encapsulated inside the cartridge and is exposed at the time of injection process, or inbuilt hypodermic needle is safely guarded by needle guard out the fluid-cartridge.
Another object of the present invention is to provide the fluid-cartridge having the piston assembly with means to dislodge the retractable needle from its own engagement means and engage itself with the retractable needle assembly to retain it after the completion of the injection process.

Another object of the present invention is to provide the fluid-cartridge having the piston assembly with means to engage with plunger shaft of the injector, which may axially move the piston assembly in forward and backward directions.

Another object of the present invention is to provide the fluid-cartridge having a fluid container with engagement means to axially engage/attach with the injector to constitute the fluid injecting system.

Another object of the present invention is to provide the fluid injecting system comprising the injector having attachments means at its proximal end to firmly attach with the fluid-cartridge during the injection process.

Another object of the present invention is to provide the fluid injecting system comprising the injector wherein the plunger assembly consisting of inner and outer plunger barrels wherein the substantial withdrawal of outer plunger barrel generates a vacuum between the two plunger barrels and unite them to constitute a single plunger unit by activating locking means provided with the inner plunger barrel.

Another object of the present invention is to provide the fluid injecting system with the injector wherein the inner plunger barrel is axially coupled with a plunger shaft at its proximal end, which at proximal end is provided with means to attach with piston assembly of fluid-cartridge during the injection process.

Another object of the present invention is to provide the fluid injecting system with the injector wherein assembly of plunger barrel is provided with a locking means, which operate to lock the outer plunger barrel with the inner plunger barrel on the
substantial withdrawal of outer plunger assembly in backward direction to generate a vacuum between the two barrels.

Another object of the present invention is to provide the fluid injecting system with the injector wherein the locking means provided with plunger assembly is unlocked when the locked and united plunger barrel is substantially pushed into the injector. This unlocking action releases the vacuum between the two barrels in order to fold the barrels and to bring the inner plunger barrel in original state inside the outer plunger barrel.

Another object of the present invention is to provide the fluid injecting system with the injector, wherein the plunger shaft axially attached at the proximal end of the inner plunger barrel and is provided with a locking means to attach firmly with the piston assembly of fluid-cartridge at its distal end during the injection process and detach automatically after the completion of injection process.

Another object of the present invention is to provide the fluid injecting system with the injector, wherein the plunger shaft first interlocks with the piston assembly and then pushes it in forward direction to inject the fluid of the fluid-cartridge into patient and when the last drop is injected, it withdraws automatically the piston assembly in backward direction along with the retractable needle assembly coupled with hypodermic needle after the completion of injection process without intervention of user and thereafter automatically detach itself from the piston assembly to release empty fluid-cartridge.

Another object of the present invention is to provide the fluid injecting system with the injector, wherein the plunger shaft moves the piston assembly in forward direction when the locked and united plunger barrels is pushed in forward direction but the plunger shaft retracts automatically in backward direction due to unlocking of plunger barrels and release of vacuum when the locked united plunger barrel is completely pushed onto the injector.
Another object of the present invention is to provide the fluid injecting system with the fluid collector which is configured to collect a fluid from a target and is removably connected with the injector.

Another object of the present invention is to provide a fluid injecting method for safely injecting the fluid at the injectable site without any risk of needle stick injury.

Another object of the present invention is to provide a fluid collecting method for collecting the fluid from the target.

SUMMARY OF THE INVENTION

Embodiments of the present invention aim to provide a fluid injecting system and a method thereof. The fluid injecting system is having an injector and a fluid-cartridge and is capable of retracting a hypodermic needle by virtue of self-generated vacuum and encapsulates the hypodermic needle in retracted position within the fluid-cartridge after completion of an injection process. The fluid injecting system completely prevents risk of needle stick injuries as the fluid-cartridge encapsulating the retracted needle becomes non-reusable. Further, the injector of the fluid injecting system is reusable, which may be used repeatedly in combination with the fluid-cartridge. In addition, the fluid injecting system is economical and user friendly. Also, the present invention provides a fluid collector.

In accordance with an embodiment of the present invention, the fluid injecting system comprising an injector having an injector body, a plunger shaft, a plunger assembly having an inner plunger barrel slidable within an outer plunger barrel, the inner plunger barrel having a locking means configured to restrict movement of the outer plunger barrel in forward direction, the outer plunger barrel and the inner plunger barrel are configured to form a united plunger barrel when the outer plunger barrel is pulled out at its full length, and a fluid-cartridge having injectable fluid packed between piston assembly and retractable needle assembly with (or without) a hypodermic needle
for injecting the fluid at an injectable site. The fluid-cartridge is configured to releasably engage with the injector at a proximal end of the injector. Further, a vacuum is created between the outer plunger barrel and the inner plunger barrel upon formation of the united plunger barrel. Also, forward movement of the united plunger barrel transfers the fluid from the fluid-cartridge into the injectable site. The hypodermic needle retracts within empty fluid-cartridge due to release of the vacuum and the injector is disengaged from the fluid-cartridge for reuse.

In accordance with an embodiment of the present invention, the injector body comprises a partition ring and a flange ring at a proximal end of the injector body to hold the plunger shaft in center of the injector body. Further, the injector body comprises a finger flange at a distal end of the injector body for holding the injector and an inner engagement means and an outer engagement means at the proximal end of the injector body to engage the fluid-cartridge. Preferably, the inner engagement means and the outer engagement means are, but not limited to, L-shaped grooves.

In accordance with an embodiment of the present invention, the outer plunger barrel of the plunger assembly comprises a thumb-rest at a distal end and an interiorly protruded flange rim at a proximal end of the outer plunger barrel. Further, the thumb-rest is having a rubber O-ring.

In accordance with an embodiment of the present invention, the interiorly protruded flange rim is having an inner diameter equal to an outer diameter of the inner plunger barrel of the plunger assembly. Further, the outer plunger barrel of the plunger assembly is having an outer diameter equal to an inner diameter of the injector body.

In accordance with an embodiment of the present invention, the inner plunger barrel of the plunger assembly comprises a piston holder at a distal end of the inner plunger barrel of the plunger assembly to hold a piston seal between exterior of the inner plunger barrel and interior of the outer plunger barrel.
In accordance with an embodiment of the present invention, the plunger shaft is configured to have an axially furrowed forceps-lock head containing two outwardly protruded flaps. Further, the two outwardly protruded flaps are configured to be sharp-edged blades at a proximal end of the flaps.

In accordance with an embodiment of the present invention, the plunger shaft is a needle shaped plunger shaft.

In accordance with an embodiment of the present invention, the locking means is housed inside the inner plunger barrel. Further, the locking means is having a conical lock-notch which protrudes out through a longitudinal slot provided at the inner plunger barrel. Also, the locking means is, but not limited to, U-clip locking means.

In accordance with an embodiment of the present invention, the plunger assembly is housed inside a distal chamber of the injector and the plunger shaft is housed axially at center of a proximal chamber of the injector.

In accordance with an embodiment of the present invention, the plunger assembly is configured to have a first spring. Further, the first spring is provided between exterior of the inner plunger barrel and interior of the outer plunger barrel of the plunger assembly.

In accordance with an embodiment of the present invention, the inner plunger barrel is provided with plurality of button cells and a LED indicator. Further, the inner plunger barrel is provided with a plurality of intrusions to hold a plurality of metallic strips to form a LED circuit.

In accordance with an embodiment of the present invention, the injector is configured to have a push-button provided at a septum at the proximal end of the injector. Preferably, the push-button is provided with a second spring.
In accordance with an embodiment of the present invention, the fluid is an injectable fluid.

In accordance with an embodiment of the present invention, the fluid-cartridge further comprises a fluid container having a distal end and a proximal end and configured to contain the fluid, a piston assembly having a piston flange and a conical cavity configured to engage the plunger shaft, a retractable needle assembly having a needle hub configured to hold the hypodermic needle, a needle holder configured to hold the needle hub, an O-ring, a cap having a plurality of horizontally extended pins towards the distal end of the fluid container and a needle guard configured to cover the hypodermic needle disposed inside the fluid container. The fluid container comprises engagement means at the distal end of the fluid container to couple with the injector body. Further, the proximal end of the fluid container is provided with a centrally opened conical mouth to hold the needle hub. The plurality of horizontally extended pins of the cap is configured to pass through a plurality of clefts of the O-ring to slidably hold the O-ring. Also, the cap is configured to hold the needle holder. The needle guard is drawn out by a user allowing the hypodermic needle along with the needle guard to extend out of the needle holder. The united plunger barrel of the injector is pushed in forward direction to couple or interlock the plunger shaft with the conical cavity of the piston assembly forming a single plunger unit. The single plunger unit exerts a downward pressure on the fluid for injecting the fluid through the hypodermic needle at the injectable site and the single plunger unit also exerts a downward pressure on the plurality of horizontally extended pins of the cap for injecting the remaining fluid at the injectable site and releasing the needle holder along with the hypodermic needle.

In accordance with an embodiment of the present invention, the engagement means are, but not limited to, protrusions provided at both interior and exterior of the fluid container.

In accordance with an embodiment of the present invention, the piston flange is configured to have a needle catch projection at center of the piston assembly at a
proximal end of the piston assembly. Further, the needle catch projection is configured to have a conical ridge at a proximal end of the needle catch projection.

In accordance with an embodiment of the present invention, the needle catch projection is configured to have, but not limited to, a longitudinal furrow or a conical groove at surface of the needle catch projection.

In accordance with an embodiment of the present invention, the piston flange is configured to have plurality of grooves to hold a piston seal between the piston flange and the fluid container.

In accordance with an embodiment of the present invention, the needle hub comprises of a conical cavity at a distal end of the needle hub to couple with the piston assembly. Further, the needle hub holds the hypodermic needle at center position at a proximal end of the needle hub. Also, the needle hub is configured to have a conical ridge at the proximal end of the needle hub.

In accordance with an embodiment of the present invention, the needle holder is configured to have a conical cavity with a conical groove at a proximal end of the needle holder.

In accordance with an embodiment of the present invention, the needle holder and the needle hub are configured to fuse together.

In accordance with an embodiment of the present invention, the needle guard is configured to cover the hypodermic needle using a locking means. Further, the needle guard is configured to have a knob like structure at a proximal end of the needle guard.

In accordance with an embodiment of the present invention, the needle guard is rotated in an anti-clockwise direction at a predetermined angle and drawn to separate from the hypodermic needle. Further, the predetermined angle is 90°.
In accordance with an embodiment of the present invention, the needle guard is having an outer diameter equal to the centrally opened conical mouth of the fluid container.

In accordance with an embodiment of the present invention, the fluid container is configured to have a rubber cap at the distal end of the fluid container.

In accordance with an embodiment of the present invention, the piston assembly is configured to have a cylindrical saw blade.

In accordance with an embodiment of the present invention, the retractable needle assembly is configured to have a thin layer circular diaphragm between the O-ring and the needle holder.

In accordance with an embodiment of the present invention, the piston flange is configured to have a circular ridge projection at a proximal end of the piston flange.

In accordance with an embodiment of the present invention, the needle holder of the retractable needle assembly is configured to have a flange rim with a collar projection at a distal end of the needle holder for holding the O-ring. Further, the O-ring is having an inner diameter at a proximal end of the O-ring greater than an inner diameter of the O-ring at a distal end of the O-ring to engage the O-ring around the collar projection.

In accordance with an embodiment of the present invention, the hypodermic needle extends out of the centrally open conical mouth due to pressure exerted on the united plunger barrel.

In accordance with an embodiment of the present invention, the fluid is sandwiched between the piston assembly and the retractable needle assembly.
In accordance with an embodiment of the present invention, the fluid collector configured to releasably engage with the injector comprising a fluid container configured to have a centrally extended conical projection containing a detachable needle holder at a proximal end of the conical projection to hold a detachable hypodermic needle, a piston assembly having a piston flange provided with a conical cavity at center of the piston assembly at a distal end of the piston assembly to couple with the plunger shaft of the injector, a container cover being internally provided with a concave diaphragm having a central hole to allow entry of the detachable hypodermic needle along with a detachable needle hub. The container cover is removably attached with the fluid container. Further, the fluid container is provided with engagement means at the distal end to engage with the injector body. The united plunger barrel of the injector retaining the vacuum is pushed completely in forward direction to attach the plunger shaft with the conical cavity of the piston assembly. Further, release of the vacuum results in backward movement of the inner plunger barrel of the united plunger barrel along with the piston assembly, which finally results in suction of a fluid from the intended target into the fluid container.

In accordance with an embodiment of the present invention, the fluid container comprises a thin layer of diaphragm at a distal end of the fluid container.

In accordance with an embodiment of the present invention, the piston flange is configured to have a plurality of grooves to hold a piston seal between the piston flange and the fluid container.

In accordance with an embodiment of the present invention, the container cover is having an internal diameter higher than an outer diameter of the fluid container at a proximal end of the fluid container to attach with the fluid container. Further, the container cover is attached with the fluid container by way of a removable ring seal to cover the proximal end of the fluid container.
In accordance with an embodiment of the present invention, the concave diaphragm is provided in middle of the container cover.

In accordance with an embodiment of the present invention, the central hole is configured to have a diameter lesser than the detachable needle hub.

In accordance with an embodiment of the present invention, the concave diaphragm is divided into a plurality of equal parts which are configured to be pressed only towards bottom of the container cover to increase size of the central hole to allow entry of the detachable hypodermic needle along with the detachable needle hub.

In accordance with an embodiment of the present invention, the fluid injecting method comprising the steps of providing a fluid-cartridge having a fluid sandwiched between a piston assembly and a retractable needle assembly of the fluid-cartridge, reversibly coupling the fluid-cartridge with an injector having a plunger shaft and a united plunger barrel and pushing the united plunger barrel in a forward direction to deliver the fluid from the fluid-cartridge into an injectable site.

In accordance with an embodiment of the present invention, the injector having an inner plunger barrel slidable within an outer plunger barrel and the united plunger barrel is formed by pulling out the outer plunger barrel completely. Further, the united plunger barrel is configured to retain a vacuum between the inner plunger barrel and the outer plunger barrel.

In accordance with an embodiment of the present invention, the injector is configured for actuating an axial movement of the plunger shaft in the forward direction and in a backward direction for retracting the plunger shaft.

In accordance with an embodiment of the present invention, the fluid is an injectable fluid.
In accordance with an embodiment of the present invention, the fluid-cartridge is reversibly coupled with the injector at a proximal end of the injector.

In accordance with an embodiment of the present invention, the fluid collecting method comprising the steps of providing a fluid collector having a piston assembly and a detachable hypodermic needle covered by a container cover, reversibly coupling the fluid collector with an injector having a plunger shaft and a united plunger barrel, removing the container cover from the fluid collector to expose the detachable hypodermic needle, inserting the detachable hypodermic needle into a target fluid source and collecting a fluid from the target fluid source into the fluid collector.

In accordance with an embodiment of the present invention, the step of inserting further comprises a step of pushing the united plunger barrel in a forward direction to attach the plunger shaft of the injector with the piston assembly of the fluid collector.

In accordance with an embodiment of the present invention, the injector having an inner plunger barrel slidable within an outer plunger barrel and the united plunger barrel is formed by pulling out the outer plunger barrel completely. Further, the united plunger barrel is configured to retain a vacuum between the inner plunger barrel and the outer plunger barrel.

In accordance with an embodiment of the present invention, the injector is configured for actuating an axial movement of the plunger shaft in a forward direction and in a backward direction for retracting the plunger shaft.

In accordance with an embodiment of the present invention, the fluid collector is reversibly coupled with the injector at a proximal end of the injector.

**BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS**

The manner, in which the above-recited features of the present invention may be understood in detail, more particular description of the invention briefly summarized
In accordance with an embodiment of the present invention, the fluid-cartridge is reversibly coupled with the injector at a proximal end of the injector.

In accordance with an embodiment of the present invention, the fluid collecting method comprising the steps of providing a fluid collector having a piston assembly and a detachable hypodermic needle covered by a container cover, reversibly coupling the fluid collector with an injector having a plunger shaft and a united plunger barrel, removing the container cover from the fluid collector to expose the detachable hypodermic needle, inserting the detachable hypodermic needle into a target fluid source and collecting a fluid from the target fluid source into the fluid collector.

In accordance with an embodiment of the present invention, the step of inserting further comprises a step of pushing the united plunger barrel in a forward direction to attach the plunger shaft of the injector with the piston assembly of the fluid collector.

In accordance with an embodiment of the present invention, the injector having an inner plunger barrel slidable within an outer plunger barrel and the united plunger barrel is formed by pulling out the outer plunger barrel completely. Further, the united plunger barrel is configured to retain a vacuum between the inner plunger barrel and the outer plunger barrel.

In accordance with an embodiment of the present invention, the injector is configured for actuating an axial movement of the plunger shaft in a forward direction and in a backward direction for retracting the plunger shaft.

In accordance with an embodiment of the present invention, the fluid collector is reversibly coupled with the injector at a proximal end of the injector.

**BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS**

The manner, in which the above-recited features of the present invention may be understood in detail, more particular description of the invention briefly summarized
above, have been referred by the embodiments, some of which are illustrated in the appended drawings. It may, however, be noted, that the drawings appended herein illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

These and other features, benefits and advantages of the present invention will become apparent by reference to the following text figure, with like reference numbers referring to like structures across the views, wherein:

Fig. 1 illustrates a perspective view of a fluid injecting system in accordance with an embodiment of the present invention.

Fig. 2 illustrates a perspective view of an injector of the fluid injecting system in accordance with an embodiment of the present invention.

Fig. 3 illustrates a perspective view of a fluid-cartridge of the fluid injecting system in accordance with an embodiment of the present invention.

Fig. 3(a) illustrates various needle catch projections of the fluid-cartridge in accordance with an embodiment of the present invention.

Figs. 4(a), (a'), (b), (b'), (c) and (c') illustrate various types of the fluid-cartridges having a needle retraction mechanism in accordance with an embodiment of the present invention.

Figs. 5(a), (a'), (b), (b'), (c) and (c') illustrate various types of the fluid-cartridges having another needle retraction mechanism in accordance with another embodiment of the present invention.

Figs. 6(a), (a'), (b), (b'), (c) and (c') illustrate various types of the fluid-cartridges
having yet another needle retraction mechanism in accordance with yet another embodiment of the present invention.

Figs. 7(a) to 7(l) illustrate schematic details of operation of the fluid injecting system in accordance with an embodiment of the present invention.

Figs. 8(a) to 8(l) illustrate schematic details of operation of the fluid injecting system in accordance with another embodiment of the present invention.

Figs. 9(a) to 9(m) illustrate schematic details of operation of the fluid injecting system in accordance with yet another embodiment of the present invention.

Fig. 10 illustrates schematic details of operation of the fluid injecting system in accordance with yet another embodiment of the present invention.

Fig. 11 illustrates a perspective view of a fluid collector in accordance with an embodiment of the present invention.

Figs. 12(a) to 12(o) illustrate schematic details of operation of the fluid collector in accordance with an embodiment of the present invention.

Fig. 13 illustrates (a) a hollow barrel ring; and (b), (c) insertion of the hollow barrel ring in the fluid collector in accordance with an embodiment of the present invention.

Fig. 14 is a flow chart illustrating fluid injecting method in accordance with an embodiment of the present invention.

Fig. 15 is a flow chart illustrating a fluid collecting method in accordance with an embodiment of the present invention.
DETAILED DESCRIPTION OF THE ACCOMPANYING DRAWINGS

While the present invention is described herein by way of example using embodiments and illustrative drawings, those skilled in the art will recognize that the invention is not limited to the embodiments of drawing or drawings described, and are not intended to represent the scale of the various components. Further, some components that may form a part of the invention may not be illustrated in certain figures for ease of illustration, and such omissions do not limit the embodiments outlined in any way. It should be understood that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the invention is to cover all modifications, equivalents and alternatives falling within the scope of the present invention as defined by the appended claim. As used throughout this description, the word "may" is used in a permissive sense (i.e. meaning having the potential to), rather than the mandatory sense (i.e. meaning must). Further, the words "a" or "an" mean "at least one" and the word "plurality" means "one or more" unless otherwise mentioned. Furthermore, the terminology and phraseology used herein is solely used for descriptive purposes and should not be construed as limiting in scope. Language such as "including," "comprising," "having," "containing," or "involving," and variations thereof, is intended to be broad and encompass the subject matter listed thereafter, equivalents, and additional subject matter not recited, and is not intended to exclude other additives, components, integers or steps. Likewise, the term "comprising" is considered synonymous with the terms "including" or "containing" for applicable legal purposes. Any discussion of documents, acts, materials, devices, articles and the like is included in the specification solely for the purpose of providing a context for the present invention. It is not suggested or represented that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention.

In this disclosure, whenever a composition or an element or a group of elements is preceded with the transitional phrase "comprising", it is understood that we also contemplate the same composition, element or group of elements with transitional phrases "consisting of", "consisting", "selected from the group of consisting of,"
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In this disclosure, whenever a composition or an element or a group of elements is preceded with the transitional phase "comprising", it is understood that we also contemplate the same composition, element or group of elements with transitional phrases "consisting of", "consisting", "selected from the group of consisting of,"
“including”, or “is” preceding the recitation of the composition, element or group of elements and vice versa.

The present invention is described hereinafter by various embodiments with reference to the accompanying drawing, wherein reference numerals used in the accompanying drawing correspond to the like elements throughout the description. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiment set forth herein. Rather, the embodiment is provided so that this disclosure will be thorough and complete and will fully convey the scope of the invention to those skilled in the art. In the following detailed description, numeric values and ranges are provided for various aspects of the implementations described. These values and ranges are to be treated as examples only, and are not intended to limit the scope of the claims. In addition, number of materials are identified as suitable for various facets of the implementations. These materials are to be treated as exemplary, and are not intended to limit the scope of the invention.

Referring to the drawings, the invention will now be described in more detail. In accordance with an embodiment of the present invention, the fluid injecting system (100), as showed in figure 1, comprising an injector (A) and a fluid-cartridge (B).

In accordance with an embodiment of the present invention, the injector (A), as shown in figure 2, comprises an injector body (10), a plunger assembly (20) and a plunger shaft (30). Further, the injector body (10) is a uniformly hollow, regular cylindrical body, which opens at both ends. The injector body (10) is having a partition ring (11) and a flange ring (12) at a proximal end (P') of the injector body (10) to hold the plunger shaft (30) in center of the injector body (10).

In accordance with an embodiment of the present invention, the injector body (10) further comprises of a finger flange (15) at a distal end (D) of the injector body (10) for holding the injector (A) and an inner engagement means (14b) and an outer engagement means (14a) at the proximal end (P') of the injector body (10) to firmly hold
“including”, or “is” preceding the recitation of the composition, element or group of elements and vice versa.

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In accordance with an embodiment of the present invention, the injector body (10) further comprises of a finger flange (15) at a distal end (D) of the injector body (10) for holding the injector (A) and an inner engagement means (14b) and an outer engagement means (14a) at the proximal end (P') of the injector body (10) to firmly hold
the fluid-cartridge (B) during an injection process. The inner engagement means (14b) and the outer engagement means (14a) are L-shaped grooves provided at both interior and exterior of the injector body (10) to firmly hold the fluid-cartridge (B) of smaller diameter and the fluid-cartridge (B) of larger diameter, respectively.

In accordance with an embodiment of the present invention, the plunger assembly (20) is having an inner plunger barrel (21) and an outer plunger barrel (22). Further, the inner plunger barrel (21) is slidable within the outer plunger barrel (22).

In accordance with an embodiment of the present invention, the outer plunger barrel (22) comprises of a uniformly regular and hollow cylindrical body having a thumb-rest (23) at a distal end (E) and an interiorly protruded flange rim (24) at a proximal end (F) of the outer plunger barrel (22). The thumb-rest (23) is configured to firmly hold a rubber O-ring (28). Further, an inner diameter of the interiorly protruded flange rim (24) is equal to the outer diameter of the inner plunger barrel (21). The outer plunger barrel (22) is having an outer diameter equal to inner diameter of the injector body (10) to facilitate smooth slidable axial movement of the outer plunger barrel (22) inside the injector body (10).

In accordance with an embodiment of the present invention, the inner plunger barrel (21) comprises of a uniformly regular and hollow cylindrical body having a piston seal holder (25) at a distal end (G) of the inner plunger barrel (21) to firmly hold a piston seal (26) between exterior of the inner plunger barrel (21) and interior of the outer plunger barrel (22). The inner plunger barrel (21) opens at a proximal end (H) and is configured to have a plurality of engagement means (27a) to firmly hold a distal end (J) of the plunger shaft (30) by way of a plurality of engagement means (27b).

In accordance with an embodiment of the present invention, the inner plunger barrel (21) comprises locking means. Further, the locking means is a U-clip locking means (35) which is disposed inside the inner plunger barrel (21). The U-clip locking means (35) contains a conical lock-notch (34) at the distal end (G), which protrudes out passing through a longitudinal slot place (36) provided at the distal end (G) of the inner
the fluid-cartridge (B) during an injection process. The inner engagement means (14b) and the outer engagement means (14a) are L-shaped grooves provided at both interior and exterior of the injector body (10) to firmly hold the fluid-cartridge (B) of smaller diameter and the fluid-cartridge (B) of larger diameter, respectively.

In accordance with an embodiment of the present invention, the plunger assembly (20) is having an inner plunger barrel (21) and an outer plunger barrel (22). Further, the inner plunger barrel (21) is slidable within the outer plunger barrel (22).

In accordance with an embodiment of the present invention, the outer plunger barrel (22) comprises of a uniformly regular and hollow cylindrical body having a thumb-rest (23) at a distal end (E) and an interiorly protruded flange rim (24) at a proximal end (F) of the outer plunger barrel (22). The thumb-rest (23) is configured to firmly hold a rubber O-ring (28). Further, an inner diameter of the interiorly protruded flange rim (24) is equal to the outer diameter of the inner plunger barrel (21). The outer plunger barrel (22) is having an outer diameter equal to inner diameter of the injector body (10) to facilitate smooth slidable axial movement of the outer plunger barrel (22) inside the injector body (10).

In accordance with an embodiment of the present invention, the inner plunger barrel (21) comprises of a uniformly regular and hollow cylindrical body having a piston seal holder (25) at a distal end (G) of the inner plunger barrel (21) to firmly hold a piston seal (26) between exterior of the inner plunger barrel (21) and interior of the outer plunger barrel (22). The inner plunger barrel (21) opens at a proximal end (H) and is configured to have a plurality of engagement means (27a) to firmly hold a distal end (J) of the plunger shaft (30) by way of a plurality of engagement means (27b).

In accordance with an embodiment of the present invention, the inner plunger barrel (21) comprises locking means. Further, the locking means is a U-clip locking means (35) which is disposed inside the inner plunger barrel (21). The U-clip locking means (35) contains a conical lock-notch (34) at the distal end (G), which protrudes out passing through a longitudinal slot place (36) provided at the distal end (G) of the inner
plunger barrel (21).

In accordance with an embodiment of the present invention, the outer plunger barrel (22) is configured for reversible engagement with locking means of the inner plunger barrel (21) to restrict movement of the outer plunger barrel (22) in forward direction facilitating the outer plunger barrel (22) and the inner plunger barrel (21) to unite forming a united plunger barrel (40), when the outer plunger barrel (22) is pulled out at its full length. Further, a vacuum (V) is generated between the outer plunger barrel (22) and the inner plunger barrel (21) upon formation of the united plunger barrel (40), as shown in figure 7(e).

In other words, the interiorly protruded flange rim (24) of the outer plunger barrel (22) passes over the conical lock-notch (34), when the outer plunger barrel (22) is pulled out in a backward direction. While passing over the conical lock-notch (34) of the U-clip locking means (35), the interiorly protruded flange rim (24) presses the conical lock-notch (34) inwardly to allow the flange rim (24) to slidably pass over the conical lock-notch (34) and move in backward direction, thereafter, the conical lock-notch (34) opens and retains its original state which restricts the movement of the outer plunger barrel (22) in forward direction. Thus, the U-clip locking means (35) facilitates the outer plunger barrel (22) and the inner plunger barrel (21) to unite to form the united plunger barrel (40).

In accordance with an embodiment of the present invention, the plunger shaft (30) is a straight rod like structure of desirable length and is provided with the plurality of engagement means (27b) at the distal end (J) to firmly attach with the inner plunger barrel (21). The plunger shaft (30) is configured to have an axially furrowed forceps-lock head (31) containing two outwardly protruded flaps (32) at a proximal end (K) on both sides of the furrowed forceps-lock head (31). The flaps (32) are configured to be sharp-edged blades at a proximal end (K) of the flaps (32). Further, the flaps (32) slidably pass through a central passage (13) of the flange ring (12) with axial movement of the plunger shaft (30) in forward and backward directions along with respective
plunger barrel (21).

In accordance with an embodiment of the present invention, the outer plunger barrel (22) is configured for reversible engagement with locking means of the inner plunger barrel (21) to restrict movement of the outer plunger barrel (22) in forward direction facilitating the outer plunger barrel (22) and the inner plunger barrel (21) to unite forming a united plunger barrel (40), when the outer plunger barrel (22) is pulled out at its full length. Further, a vacuum (V) is generated between the outer plunger barrel (22) and the inner plunger barrel (21) upon formation of the united plunger barrel (40), as shown in figure7(e).

In other words, the interiorly protruded flange rim (24) of the outer plunger barrel (22) passes over the conical lock-notch (34), when the outer plunger barrel (22) is pulled out in a backward direction. While passing over the conical lock-notch (34) of the U-clip locking means (35), the interiorly protruded flange rim (24) presses the conical lock-notch (34) inwardly to allow the flange rim (24) to slidably pass over the conical lock-notch (34) and move in backward direction, thereafter, the conical lock-notch (34) opens and retains its original state which restricts the movement of the outer plunger barrel (22) in forward direction. Thus, the U-clip locking means (35) facilitates the outer plunger barrel (22) and the inner plunger barrel (21) to unite to form the united plunger barrel (40).

In accordance with an embodiment of the present invention, the plunger shaft (30) is a straight rod like structure of desirable length and is provided with the plurality of engagement means (27b) at the distal end (J) to firmly attach with the inner plunger barrel (21). The plunger shaft (30) is configured to have an axially furrowed forceps-lock head (31) containing two outwardly protruded flaps (32) at a proximal end (K) on both sides of the furrowed forceps-lock head (31). The flaps (32) are configured to be sharp-edged blades at a proximal end (K) of the flaps (32). Further, the flaps (32) slidably pass through a central passage (13) of the flange ring (12) with axial movement of the plunger shaft (30) in forward and backward directions along with respective
movement of the inner plunger barrel (21).

In accordance with an embodiment of the present invention, the plunger assembly (20) is housed inside a distal chamber (a) of the injector (A) and the plunger shaft (30), axially attached at the proximal end (H) of the inner plunger barrel (21) is housed axially at center of a proximal chamber (b) of the injector (A). The forceps-lock head (31) of the plunger shaft (30) passes through the flange ring (12) through the central passage (13) and the forceps-lock head (31) remains initially in closed position due to pressed flaps (32) when held within the central passage (13) of the flange ring (12).

In accordance with an embodiment of the present invention, the plunger assembly (20) is configured to have a first spring. Further, the first spring is provided between exterior of the inner plunger barrel (21) and interior of the outer plunger barrel (22) of the plunger assembly (20).

In accordance with an embodiment of the present invention, the proximal end (H) of the inner plunger barrel (21) is provided with plurality of button cells (41) and a LED indicator (42) enabling an injectable site to be visible by way of tyndall effect on a fluid (53) facilitating the injection process in dark too. An outer surface of the inner plunger barrel (21) is provided with a plurality of intrusions to hold a plurality of metallic strips to form a LED circuit. The LED indicator (42) is configured to switch on as soon as the outer plunger barrel (22) is pulled in the backward direction and the vacuum (V) is created in the united plunger barrel (40). Further, the LED indicator (42) is configured to switch off on completion of the injection process, as and when the vacuum (V) is released and the outer plunger barrel (22) as well as the inner plunger barrel (21) retain their initial states. Further, the injector (A) is having a push-button (43) placed on a septum (44) at a proximal end (P) of the injector (A). Preferably, the push-button (43) is provided with a second spring (45). The push-button (43) may be used, if required, to restrict and conveniently control the backward movement of the united plunger barrel (40) during a fluid collection process by pressing the push-button (43).
movement of the inner plunger barrel (21).

In accordance with an embodiment of the present invention, the plunger assembly (20) is housed inside a distal chamber (a) of the injector (A) and the plunger shaft (30), axially attached at the proximal end (H) of the inner plunger barrel (21) is housed axially at center of a proximal chamber (b) of the injector (A). The forceps-lock head (31) of the plunger shaft (30) passes through the flange ring (12) through the central passage (13) and the forceps-lock head (31) remains initially in closed position due to pressed flaps (32) when held within the central passage (13) of the flange ring (12).

In accordance with an embodiment of the present invention, the plunger assembly (20) is configured to have a first spring. Further, the first spring is provided between exterior of the inner plunger barrel (21) and interior of the outer plunger barrel (22) of the plunger assembly (20).

In accordance with an embodiment of the present invention, the proximal end (H) of the inner plunger barrel (21) is provided with plurality of button cells (41) and a LED indicator (42) enabling an injectable site to be visible by way of tyndall effect on a fluid (53) facilitating the injection process in dark too. An outer surface of the inner plunger barrel (21) is provided with a plurality of intrusions to hold a plurality of metallic strips to form a LED circuit. The LED indicator (42) is configured to switch on as soon as the outer plunger barrel (22) is pulled in the backward direction and the vacuum (V) is created in the united plunger barrel (40). Further, the LED indicator (42) is configured to switch off on completion of the injection process, as and when the vacuum (V) is released and the outer plunger barrel (22) as well as the inner plunger barrel (21) retain their initial states. Further, the injector (A) is having a push-button (43) placed on a septum (44) at a proximal end (P) of the injector (A). Preferably, the push-button (43) is provided with a second spring (45). The push-button (43) may be used, if required, to restrict and conveniently control the backward movement of the united plunger barrel (40) during a fluid collection process by pressing the push-button (43).
In accordance with an embodiment of the present invention, the fluid-cartridge (B), as shown in Figure 3, comprises the fluid (53) and a hypodermic needle (72) for injecting the fluid (53) at the injectable site. The fluid-cartridge (B) may be releasably engaged with the injector (A) at the proximal end (P) of the injector (A). Further, the fluid-cartridge (B) is having a constant length. Also, the fluid (53) is an injectable fluid.

In accordance with an embodiment of the present invention, the fluid-cartridge (B) further comprises a fluid container (50), a piston assembly (60) and a retractable needle assembly (70).

In accordance with an embodiment of the present invention, the fluid container (50) is a uniformly regular and hollow cylindrical body opening at both distal end (M) and proximal end (M’) and is configured to contain the fluid (53). The fluid container (50) is having engagement means (14a’, 14b’) at the distal end (M) of the fluid container (50) to firmly engage within the L-shaped grooves of the inner engagement means (14b) and the outer engagement means (14a) of the injector body (10). Further, the engagement means (14a’, 14b’) are protrusions provided at both interior and exterior of the fluid container (50).

In accordance with an embodiment of the present invention, the piston assembly (60) comprises a piston flange (61) and a conical cavity (66) to receive and retain the forceps-lock head (31) during the injection process. The piston flange (61) is configured to have a needle catch projection (65) at center of the piston assembly (60) at a proximal end (N) of the piston assembly (60).

The needle catch projection (65) may be provided with a longitudinal furrow (F’) or a conical groove (Gr) at surface as shown in figures 3 (a) (i) and 3 (a) (ii). The needle catch projection (65) is also provided with a conical ridge (68) at a proximal end (N’) of the needle catch projection (65). Further, rim of the piston flange (61) is configured to have plurality of grooves (82) to hold a piston seal (63) between the piston flange (61)
In accordance with an embodiment of the present invention, the fluid-cartridge (B), as shown in figure 3, comprises the fluid (53) and a hypodermic needle (72) for injecting the fluid (53) at the injectable site. The fluid-cartridge (B) may be releasably engaged with the injector (A) at the proximal end (P) of the injector (A). Further, the fluid-cartridge (B) is having a constant length. Also, the fluid (53) is an injectable fluid.

In accordance with an embodiment of the present invention, the fluid-cartridge (B) further comprises a fluid container (50), a piston assembly (60) and a retractable needle assembly (70).

In accordance with an embodiment of the present invention, the fluid container (50) is a uniformly regular and hollow cylindrical body opening at both distal end (M) and proximal end (M') and is configured to contain the fluid (53). The fluid container (50) is having engagement means (14a', 14b') at the distal end (M) of the fluid container (50) to firmly engage within the L-shaped grooves of the inner engagement means (14b) and the outer engagement means (14a) of the injector body (10). Further, the engagement means (14a', 14b') are protrusions provided at both interior and exterior of the fluid container (50).

In accordance with an embodiment of the present invention, the piston assembly (60) comprises a piston flange (61) and a conical cavity (66) to receive and retain the forceps-lock head (31) during the injection process. The piston flange (61) is configured to have a needle catch projection (65) at center of the piston assembly (60) at a proximal end (N) of the piston assembly (60).

The needle catch projection (65) may be provided with a longitudinal furrow(F') or a conical groove (Gr) at surface as shown in figures3 (a) (i) and 3 (a) (ii). The needle catch projection (65) is also provided with a conical ridge (68) at a proximal end (N') of the needle catch projection (65). Further, rim of the piston flange (61) is configured to have plurality of grooves (82) to hold a piston seal (63) between the piston flange (61)
and the fluid container (50).

In accordance with an embodiment of the present invention, the conical cavity (66) is positioned at center of the piston assembly (60) at a distal end (O) of the piston assembly (60) to receive and retain the forceps-lock head (31) during the injection process. The conical cavity (66) is having an opening diameter greater than an outer diameter of closed forceps-lock head (31) of the plunger shaft (30) to receive the closed forceps-lock head (31) conveniently, whereas, the opening diameter of the conical cavity (66) is lesser than the inner diameter of the conical cavity (66) to firmly engage with opened forceps-lock head (31) of the plunger shaft (30).

In accordance with an embodiment of the present invention, the retractable needle assembly (70) comprises a needle hub (71) configured to hold the hypodermic needle (72), a needle holder (74) configured to hold the needle hub (71), an O-ring (79), a cap (84) having a plurality of horizontally extended pins (86) towards the distal end (M) of the fluid container (50) and a needle guard (85) configured to cover the hypodermic needle (72) disposed inside the fluid container (50). Further, the hypodermic needle (72) is uniformly hollow regular and straight, and of desired dimensions. Furthermore, the retractable needle assembly (70) may be provided without the hypodermic needle (72).

In accordance with an embodiment of the present invention, the needle hub (71) comprises of a conical cavity (75) at a distal end (R) of the needle hub (71). The conical cavity (75) is configured to have a conical groove (73) at a proximal end (R') of the conical cavity (75) which is slightly greater in diameter than the conical ridge (68) of the needle catch projection (65) of the piston flange (61) to conveniently receive and fixedly engage with the needle catch projection (65). An outer diameter of the needle hub (71) at the distal end (R) is comparatively greater than a proximal end (S) of the needle hub (71) to constitute a cone shaped structure, which is provided with a conical ridge (76) at the proximal end (S) of the needle hub (71) to fixedly attach within a conical groove (91) of a conical cavity (77) of the needle holder (74) at a proximal end (T) of the needle
and the fluid container (50).

In accordance with an embodiment of the present invention, the conical cavity (66) is positioned at center of the piston assembly (60) at a distal end (O) of the piston assembly (60) to receive and retain the forceps-lock head (31) during the injection process. The conical cavity (66) is having an opening diameter greater than an outer diameter of closed forceps-lock head (31) of the plunger shaft (30) to receive the closed forceps-lock head (31) conveniently, whereas, the opening diameter of the conical cavity (66) is lesser than the inner diameter of the conical cavity (66) to firmly engage with opened forceps-lock head (31) of the plunger shaft (30).

In accordance with an embodiment of the present invention, the retractable needle assembly (70) comprises a needle hub (71) configured to hold the hypodermic needle (72), a needle holder (74) configured to hold the needle hub (71), an O-ring (79), a cap (84) having a plurality of horizontally extended pins (86) towards the distal end (M) of the fluid container (50) and a needle guard (85) configured to cover the hypodermic needle (72) disposed inside the fluid container (50). Further, the hypodermic needle (72) is uniformly hollow regular and straight, and of desired dimensions. Furthermore, the retractable needle assembly (70) may be provided without the hypodermic needle (72).

In accordance with an embodiment of the present invention, the needle hub (71) comprises of a conical cavity (75) at a distal end (R) of the needle hub (71). The conical cavity (75) is configured to have a conical groove (73) at a proximal end (R') of the conical cavity (75) which is slightly greater in diameter than the conical ridge (68) of the needle catch projection (65) of the piston flange (61) to conveniently receive and fixedly engage with the needle catch projection (65). An outer diameter of the needle hub (71) at the distal end (R) is comparatively greater than a proximal end (S) of the needle hub (71) to constitute a cone shaped structure, which is provided with a conical ridge (76) at the proximal end (S) of the needle hub (71) to fixedly attach within a conical groove (91) of a conical cavity (77) of the needle holder (74) at a proximal end (T) of the needle.
holder (74). Further, the needle hub (71) holds the hypodermic needle (72) at center position at a proximal end (S) of the needle hub (71). The hypodermic needle (72) is encapsulated inside the needle guard (85) with the help of a locking means (90). The needle guard (85) may be removed from the needle hub (71) to expose the hypodermic needle (72) by drawing out and thereafter, rotating the needle guard (85) in an anti-clockwise direction at 90-degree angle with the help of a knob like structure (89) provided at a proximal end (X) of the needle guard (85). The proximal end (M') of the fluid container (50) is provided with a centrally opened conical mouth (51) to hold the retractable needle assembly (70). Further, the needle guard (85) may be provided without the knob like structure (89).

In accordance with an embodiment of the present invention, an inner diameter of the conical cavity (75) of the needle hub (71) is equal to an outer diameter of the needle catch projection (65) of the piston flange (61) to receive and firmly engage with the needle catch projection (65).

In accordance with an embodiment of the present invention, an inner diameter of the conical cavity (77) of the needle holder (74) is equal to an outer diameter of the needle hub (71) to receive and firmly engage with the needle hub (71). Further, the inner diameter of a conical cavity of the cap (84) is equal to the outer diameter of the needle holder (74) to receive and firmly engage with the needle holder (74). Furthermore, the needle holder (74) and the needle hub (71) may be fused together.

In accordance with an embodiment of the present invention, the plurality of horizontally extended pins (86) of the cap (84) are configured to pass through a plurality of clefts of the O-ring (79) to slidably hold the O-ring (79). The cap (84) is provided with a flange (87) at a proximal end (T) of the cap (84) and the conical cavity of the cap (84) is configured to hold the needle holder (74). Further, the needle holder (74) and the cap (84) are provided at the proximal end (M') of the fluid container (50).

In accordance with an embodiment of the present invention, the needle holder
Further, the needle hub (71) holds the hypodermic needle (72) at center position at a proximal end (S) of the needle hub (71). The hypodermic needle (72) is encapsulated inside the needle guard (85) with the help of a locking means (90). The needle guard (85) may be removed from the needle hub (71) to expose the hypodermic needle (72) by drawing out and thereafter, rotating the needle guard (85) in an anti-clockwise direction at 90-degree angle with the help of a knob like structure (89) provided at a proximal end (X) of the needle guard (85). The proximal end (M') of the fluid container (50) is provided with a centrally opened conical mouth (51) to hold the retractable needle assembly (70). Further, the needle guard (85) may be provided without the knob like structure (89).

In accordance with an embodiment of the present invention, an inner diameter of the conical cavity (75) of the needle hub (71) is equal to an outer diameter of the needle catch projection (65) of the piston flange (61) to receive and firmly engage with the needle catch projection (65).

In accordance with an embodiment of the present invention, an inner diameter of the conical cavity (77) of the needle holder (74) is equal to an outer diameter of the needle hub (71) to receive and firmly engage with the needle hub (71). Further, the inner diameter of a conical cavity of the cap (84) is equal to the outer diameter of the needle holder (74) to receive and firmly engage with the needle holder (74). Furthermore, the needle holder (74) and the needle hub (71) may be fused together.

In accordance with an embodiment of the present invention, the plurality of horizontally extended pins (86) of the cap (84) are configured to pass through a plurality of clefts of the O-ring (79) to slidably hold the O-ring (79). The cap (84) is provided with a flange (87) at a proximal end (T) of the cap (84) and the conical cavity of the cap (84) is configured to hold the needle holder (74). Further, the needle holder (74) and the cap (84) are provided at the proximal end (M') of the fluid container (50).

In accordance with an embodiment of the present invention, the needle holder
(74) has an outer diameter equal to an inner diameter of the O-ring (79) as well as an inner diameter of the cap (84). Further, an inner surface of the conical cavity (77) of the needle holder (74) at a proximal end (T’) is provided with uniform fine groove linings (88) which are uniformly similar and equal in numbers to fixedly hold and accommodate all the groove linings (92) provided at the proximal end (S) of an outer surface of the needle hub (71) to prevent rotation of the needle hub (71), while rotating the needle guard (85) in the anti-clockwise direction in order to remove the needle guard (85) to expose the hypodermic needle (72) before the injection process.

In accordance with an embodiment of the present invention, the O-ring (79) has an outer diameter equal to an inner diameter of the fluid container (50), whereas the inner diameter of the O-ring (79) is equal to the outer diameter of the needle holder (74). The O-ring (79) is provided with the plurality of clefts, exactly equal in shape and number of the horizontally extended pins (86) of the cap (84). The plurality of clefts of the O-ring (79) is configured to slidably engage with the horizontally extended pins (86) of the cap (84).

In accordance with an embodiment of the present invention, the needle guard (85) is drawn out by a user with the help of the knob like structure (89) allowing the hypodermic needle (72) along with the needle guard (85) to extend out of the needle holder (74). Further, the needle guard (85) is having an outer diameter equal to the opened conical mouth (51) of the fluid container (50).

In other words, when the needle guard (85) is drawn out by the user using the knob like structure (89), the needle hub (71) becomes fixedly engage within the conical cavity (77) of the needle holder (74) and the groove linings (88) provided in the conical cavity (77) of the needle holder (74) fixedly engage and accommodate all the groove linings (92) provided at the proximal end (S) of the needle hub (71). The needle guard (85) may be removed by rotating in the anti-clockwise direction at the 90-degree angle, which unlocks the locking means (90) and thereafter, the needle guard (85) is separated from the needle hub (71) to expose the hypodermic needle (72).
(74) has an outer diameter equal to an inner diameter of the O-ring (79) as well as an inner diameter of the cap (84). Further, an inner surface of the conical cavity (77) of the needle holder (74) at a proximal end (T') is provided with uniform fine groove linings (88) which are uniformly similar and equal in numbers to fixedly hold and accommodate all the groove linings (92) provided at the proximal end (S) of an outer surface of the needle hub (71) to prevent rotation of the needle hub (71), while rotating the needle guard (85) in the anti-clockwise direction in order to remove the needle guard (85) to expose the hypodermic needle (72) before the injection process.

In accordance with an embodiment of the present invention, the O-ring (79) has an outer diameter equal to an inner diameter of the fluid container (50), whereas the inner diameter of the O-ring (79) is equal to the outer diameter of the needle holder (74). The O-ring (79) is provided with the plurality of clefts, exactly equal in shape and number of the horizontally extended pins (86) of the cap (84). The plurality of clefts of the O-ring (79) is configured to slidably engage with the horizontally extended pins (86) of the cap (84).

In accordance with an embodiment of the present invention, the needle guard (85) is drawn out by a user with the help of the knob like structure (89) allowing the hypodermic needle (72) along with the needle guard (85) to extend out of the needle holder (74). Further, the needle guard (85) is having an outer diameter equal to the opened conical mouth (51) of the fluid container (50).

In other words, when the needle guard (85) is drawn out by the user using the knob like structure (89), the needle hub (71) becomes fixedly engage within the conical cavity (77) of the needle holder (74) and the groove linings (88) provided in the conical cavity (77) of the needle holder (74) fixedly engage and accommodate all the groove linings (92) provided at the proximal end (S) of the needle hub (71). The needle guard (85) may be removed by rotating in the anti-clockwise direction at the 90-degree angle, which unlocks the locking means (90) and thereafter, the needle guard (85) is separated from the needle hub (71) to expose the hypodermic needle (72).
In accordance with an embodiment of the present invention, the united plunger barrel (40) of the injector (A) is pushed through the thumb-rest (23) in forward direction to firmly attach the forceps-lock head (31) of the plunger shaft (30) within the conical cavity (66) of the piston assembly (60) forming a single plunger unit (67) as shown in figure 7(f). On pushing a proximal end (69) of the single plunger unit (67) in forward direction, the piston assembly (60) pushes the fluid (53) in forward direction, which is injected at the injectable site through the hypodermic needle (72). At the end point of the injection process, the proximal end (N) of the piston assembly (60) comes in close contact of the plurality of horizontally extended pins (86) and the needle catch projection (65) gently begins entering into the conical cavity (75) of the needle hub (71). Exerting further pressure by the piston assembly (60) on the plurality of horizontally extended pins (86) of the cap (84) results in sliding of the plurality of horizontally extended pins (86) in forward direction to set the needle holder (74) free in order to release the needle holder (74) holding the needle hub (71) along with the hypodermic needle (72).

Figure 4(a), (a’), (b), (b’), (c), and (c’) illustrate various types of the fluid-cartridges (B) having a needle retraction mechanism in accordance with an embodiment of the present invention.

In accordance with an embodiment of the present invention, the fluid-cartridges (B), as shown in figure 4(a) and (a’) are provided with the hypodermic needle (72) wherein the hypodermic needle (72) is required to be pulled out manually and thereafter, removing the needle guard (85). The fluid-cartridge (B) may be provided with the hypodermic needle (72) as shown in figure 4 (b) and (b’), wherein the hypodermic needle (72) comes out along with the needle guard (85) due to pressure exerted on the united plunger barrel (40). Further, the needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are fused together. Furthermore, the fluid-cartridges (B) may be provided without the hypodermic needle (72) as shown in figure 4(c) and (c’), wherein the user may attach the desired hypodermic needle (72) of desired length or bore. The needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are also fused
In accordance with an embodiment of the present invention, the united plunger barrel (40) of the injector (A) is pushed through the thumb-rest (23) in forward direction to firmly attach the forceps-lock head (31) of the plunger shaft (30) within the conical cavity (66) of the piston assembly (60) forming a single plunger unit (67) as shown in figure 7(f). On pushing a proximal end (69) of the single plunger unit (67) in forward direction, the piston assembly (60) pushes the fluid (53) in forward direction, which is injected at the injectable site through the hypodermic needle (72). At the end point of the injection process, the proximal end (N) of the piston assembly (60) comes in close contact of the plurality of horizontally extended pins (86) and the needle catch projection (65) gently begins entering into the conical cavity (75) of the needle hub (71). Exerting further pressure by the piston assembly (60) on the plurality of horizontally extended pins (86) of the cap (84) results in sliding of the plurality of horizontally extended pins (86) in forward direction to set the needle holder (74) free in order to release the needle holder (74) holding the needle hub (71) along with the hypodermic needle (72).

Figure 4(a), (a’), (b), (b’), (c) and (c’) illustrate various types of the fluid-cartridges (B) having a needle retraction mechanism in accordance with an embodiment of the present invention.

In accordance with an embodiment of the present invention, the fluid-cartridges (B), as shown in figure 4(a) and (a’) are provided with the hypodermic needle (72) wherein the hypodermic needle (72) is required to be pulled out manually and thereafter, removing the needle guard (85). The fluid-cartridge (B) may be provided with the hypodermic needle (72) as shown in figure 4(b) and (b’), wherein the hypodermic needle (72) comes out along with the needle guard (85) due to pressure exerted on the united plunger barrel (40). Further, the needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are fused together. Furthermore, the fluid-cartridges (B) may be provided without the hypodermic needle (72) as shown in figure 4(c) and (c’), wherein the user may attach the desired hypodermic needle (72) of desired length or bore. The needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are also fused
together.

As shown in figure 4 (a), (b) and (c), the fluid-cartridges (B) are releasably coupled with the injector (A) having the plunger shaft (30) with the axially furrowed forceps-lock head (31). In other embodiments, as shown in figure 4 (a’), (b’) and (c’), the fluid containers (50) of the fluid-cartridges (B) are configured to have a rubber cap (39) at the distal end (M) of the fluid container (50). Further, these fluid-cartridges (B) are releasably coupled with the injector (A) having a needle shaped plunger shaft (38).

Figure 5 (a), (a’), (b), (b’), (c) and (c’) illustrate various types of the fluid-cartridges (B) having different needle retraction mechanism in accordance with another embodiment of the present invention.

As shown in figures 5 (a), (a’), (b), (b’), (c) and (c’), the fluid-cartridges (B) are configured to have a cylindrical saw blade (59) at the proximal end (N) of the piston assembly (60) of the fluid-cartridges (B). These fluid-cartridges (B) are provided with the retractable needle assembly (70) comprising a circular O-ring (79) having the needle holder (74) at center at the proximal end (M’) of the fluid container (50). Further, the circular O-ring (79) is provided with a thin layer circular diaphragm (57) between the circular O-ring (79) and the needle holder (74).

The fluid-cartridges (B), as shown in figure 5(a) and (a’) are provided with the hypodermic needle (72) wherein the hypodermic needle (72) is required to be pulled out manually and thereafter, removing the needle guard (85). In the fluid cartridges (B) as shown in figure 5 (b) and (b’), the needle hub (71) and the needle holder (74) are fused together to constitute the retractable needle assembly (70) as a single unit which is further provided with the hypodermic needle (72) along with the needle guard (85). Further, the hypodermic needle (72) along with the needle guard (85) comes out of the fluid-cartridges (B) due to the pressure exerted on the united plunger barrel (40). Furthermore, the fluid-cartridges (B) may be provided without the hypodermic needle (72) as shown in figure 5(c) and (c’), wherein the user may attach the desired
As shown in figure 4 (a), (b) and (c), the fluid-cartridges (B) are releasably coupled with the injector (A) having the plunger shaft (30) with the axially furrowed forceps-lock head (31). In other embodiments, as shown in figure 4 (a’), (b’) and (c’), the fluid containers (50) of the fluid-cartridges (B) are configured to have a rubber cap (39) at the distal end (M) of the fluid container (50). Further, these fluid-cartridges (B) are releasably coupled with the injector (A) having a needle shaped plunger shaft (38).

Figure 5 (a), (a’), (b), (b’), (c) and (c’) illustrate various types of the fluid-cartridges (B) having different needle retraction mechanism in accordance with another embodiment of the present invention.

As shown in figures 5 (a), (a’), (b), (b’), (c) and (c’), the fluid-cartridges (B) are configured to have a cylindrical saw blade (59) at the proximal end (N) of the piston assembly (60) of the fluid-cartridges (B). These fluid-cartridges (B) are provided with the retractable needle assembly (70) comprising a circular O-ring (79) having the needle holder (74) at center at the proximal end (M) of the fluid container (50). Further, the circular O-ring (79) is provided with a thin layer circular diaphragm (57) between the circular O-ring (79) and the needle holder (74).

The fluid-cartridges (B), as shown in figure 5(a) and (a’) are provided with the hypodermic needle (72) wherein the hypodermic needle (72) is required to be pulled out manually and thereafter, removing the needle guard (85). In the fluid cartridges (B) as shown in figure 5 (b) and (b’), the needle hub (71) and the needle holder (74) are fused together to constitute the retractable needle assembly (70) as a single unit which is further provided with the hypodermic needle (72) along with the needle guard (85). Further, the hypodermic needle (72) along with the needle guard (85) comes out of the fluid-cartridges (B) due to the pressure exerted on the unit plunger barrel (40). Furthermore, the fluid-cartridges (B) may be provided without the hypodermic needle (72) as shown in figure 5(c) and (c’), wherein the user may attach the desired
hypodermic needle (72) of the desired length or bore. The needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are also fused together to constitute the retractable needle assembly (70) as a single unit.

In accordance with an embodiment of the present invention, the fluid-cartridges (B), as shown in figure 5 (a), (b) and (c), are releasably coupled with the injector (A) having the plunger shaft (30) with the axially furrowed forceps-lock head (31). As shown in figure 5 (a'), (b') and (c'), the fluid containers (50) of the fluid-cartridges (B) are configured to have the rubber cap (39) at the distal end (M) of the fluid container (50). Further, these fluid-cartridges (B) are releasably coupled with the injector (A) having the needle shaped plunger shaft (38).

Figure 6 (a), (a'), (b), (b'), (c) and (c') illustrates various types of the fluid-cartridges (B) having different needle retraction mechanism in accordance with yet another embodiment of the present invention.

As shown in figure 6 (a) and (a'), the fluid-cartridges (B) are provided with the hypodermic needle (72) wherein the hypodermic needle (72) is required to be pulled out manually and thereafter, removing the needle guard (85). The fluid-cartridge (B) may be provided with the hypodermic needle (72) as shown in figure 6 (b) and (b'), wherein the hypodermic needle (72) comes out along with the needle guard (85) due to pressure exerted on the united plunger barrel (40). Further, the needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are fused together. Furthermore, the fluid-cartridges (B) may be provided without the hypodermic needle (72) as shown in figure 6 (c) and (c'), wherein the user may attach the desired hypodermic needle (72) of the desired length or bore. The needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are also fused together.

In accordance with an embodiment of the present invention, the fluid-cartridges (B), as shown in figure 6 (a), (b) and (c), are releasably coupled with the injector (A)
hypodermic needle (72) of the desired length or bore. The needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are also fused together to constitute the retractable needle assembly (70) as a single unit.

In accordance with an embodiment of the present invention, the fluid-cartridges (B), as shown in figure 5 (a), (b) and (c), are releasably coupled with the injector (A) having the plunger shaft (30) with the axially furrowed forceps-lock head (31). As shown in figure 5 (a'), (b') and (c'), the fluid containers (50) of the fluid-cartridges (B) are configured to have the rubber cap (39) at the distal end (M) of the fluid container (50). Further, these fluid-cartridges (B) are releasably coupled with the injector (A) having the needle shaped plunger shaft (38).

Figure 6 (a), (a'), (b), (b'), (c) and (c') illustrates various types of the fluid-cartridges (B) having different needle retraction mechanism in accordance with yet another embodiment of the present invention.

As shown in figure 6 (a) and (a'), the fluid-cartridges (B) are provided with the hypodermic needle (72) wherein the hypodermic needle (72) is required to be pulled out manually and thereafter, removing the needle guard (85). The fluid-cartridge (B) may be provided with the hypodermic needle (72) as shown in figure 6 (b) and (b'), wherein the hypodermic needle (72) comes out along with the needle guard (85) due to pressure exerted on the united plunger barrel (40). Further, the needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are fused together. Furthermore, the fluid-cartridges (B) may be provided without the hypodermic needle (72) as shown in figure 6 (c) and (c'), wherein the user may attach the desired hypodermic needle (72) of the desired length or bore. The needle holder (74) and the needle hub (71) of these fluid-cartridges (B) are also fused together.

In accordance with an embodiment of the present invention, the fluid-cartridges (B), as shown in figure 6 (a), (b) and (c), are releasably coupled with the injector (A)
having the plunger shaft (30) with the axially furrowed forceps-lock head (31). As shown in figure 6 (a’), (b’) and (c’), the fluid containers (50) of the fluid-cartridges (B) are configured to have the rubber cap (39) at the distal end (M) of the fluid container (50). Further, these fluid-cartridges (B) are releasably coupled with the injector (A) having the needle shaped plunger shaft (38). Furthermore, the different needle retraction mechanisms are elaborated in figures below.

The schematic details of operation of the fluid injecting system (100) are shown in figure 7(a) to figure 7(l).

Figure 7(a) illustrates the injector (A) and the fluid-cartridge (B) as shown in figure 4(a) of the fluid injecting system (100) in accordance with an embodiment of the present invention. Prior to the injection process, the distal end (M) of the fluid container (50) of the fluid-cartridge (B) is attached at the proximal end (P) of the injector (A) through the inner engagement means (14b) and the outer engagement means (14a) of the injector body (10) of the injector (A) to the engagement means (14a’, 14b’) of the fluid container (50) to constitute the fluid injecting system (100) as shown in figure 7(b).

As shown in figure 7(c), the needle guard (85) along with the hypodermic needle (72) is drawn out by the user, which facilitates the hypodermic needle (72) along with the needle guard (85) to extend out through the opened conical mouth (51) of the fluid container (50) and the needle holder (74) click fits with the needle hub (71). Thereafter, the needle guard (85) is rotated in the anticlockwise direction by 90 degrees to unlock the locking means (90) and drawn to remove the needle guard (85) to expose the hypodermic needle (72) as shown in figure 7(d).

Figure 7(e) illustrates the united plunger barrel (40) of the fluid injecting system (100) in accordance with an embodiment of the present invention. As shown in figure 7(e), the LED indicator (42) gets switched-on and glows as soon as the vacuum (V) is generated in the united plunger barrel (40) and illuminates the end tip of the hypodermic needle (72) and surrounding area of the injectable site to indicate ongoing injection
having the plunger shaft (30) with the axially furrowed forceps-lock head (31). As shown in figure 6 (a’), (b’) and (c’), the fluid containers (50) of the fluid-cartridges (B) are configured to have the rubber cap (39) at the distal end (M) of the fluid container (50). Further, these fluid-cartridges (B) are releasably coupled with the injector (A) having the needle shaped plunger shaft (38). Furthermore, the different needle retraction mechanisms are elaborated in figures below.

The schematic details of operation of the fluid injecting system (100) are shown in figure 7(a) to figure 7(l).

Figure 7(a) illustrates the injector (A) and the fluid-cartridge (B) as shown in figure 4(a) of the fluid injecting system (100) in accordance with an embodiment of the present invention. Prior to the injection process, the distal end (M) of the fluid container (50) of the fluid-cartridge (B) is attached at the proximal end (P) of the injector (A) through the inner engagement means (14b) and the outer engagement means (14a) of the injector body (10) of the injector (A) to the engagement means (14a’, 14b’) of the fluid container (50) to constitute the fluid injecting system (100) as shown in figure 7(b).

As shown in figure 7(c), the needle guard (85) along with the hypodermic needle (72) is drawn out by the user, which facilitates the hypodermic needle (72) along with the needle guard (85) to extend out through the opened conical mouth (51) of the fluid container (50) and the needle holder (74) click fits with the needle hub (71). Thereafter, the needle guard (85) is rotated in the antihclockwise direction by 90 degrees to unlock the locking means (90) and drawn to remove the needle guard (85) to expose the hypodermic needle (72) as shown in figure 7(d).

Figure 7(e) illustrates the united plunger barrel (40) of the fluid injecting system (100) in accordance with an embodiment of the present invention. As shown in figure 7(e), the LED indicator (42) gets switched-on and glows as soon as the vacuum (V) is generated in the united plunger barrel (40) and illuminates the end tip of the hypodermic needle (72) and surrounding area of the injectable site to indicate ongoing injection
process to guide the user and to facilitate injection process in dark too. On pushing the united plunger barrel (40) through the thumb-rest (23), the forceps-lock head (31) of the plunger shaft (30) gently enters into the conical cavity (66) of the piston assembly (60) and constitutes a single plunger unit (67) as shown in figure 7(f). As soon as the flaps (32) pass through the central passage (13) of the flange ring (12), the forceps-lock head (31) opens and gets engage firmly with the piston assembly (60) occupying the inner space of the conical cavity (66). On further pushing the proximal end (69) of the single plunger unit (67), the piston assembly (60) simultaneously pushes the fluid (53) in forward direction, which is injected into the body through the hypodermic needle (72). Just before the completion of the injection process, the proximal end (N) of the piston assembly (60) comes in close contact of end tips of the plurality of horizontally extended pins (86) of the cap (84) holding the needle holder (74) and the needle hub (71), as shown in figure 7(g). On further pushing the single plunger unit (67) in forward direction, the plurality of horizontally extended pins (86) begin sliding in forward direction to dislodge the needle holder (74) from grip of the cap (84). At the same time, the needle catch projection (65) of the piston assembly (60) also gently enters into the conical cavity (75) of the needle hub (71) and gets engage therein to attach the retractable needle assembly (70) with the help of the conical ridge (76) occupying the conical groove (91) of the conical cavity (77) of the needle holder (74) as shown in figure 7(h).

At the end of the injection process, as shown in figure 7(h), the plurality of horizontally extended pins (86) holding the needle hub (71) slide completely in forward direction to dislodge the needle hub (71) along with the needle holder (74) from the close contact of the cap (84). Simultaneously, the conical lock-notch (34) firmly engaging the outer plunger barrel (22) to the inner plunger barrel (21) itself presses inwardly, while axially passing through passage of the partition ring (11) in forward direction. It unlocks and releases the outer plunger barrel (22) and consequently, the inner plunger barrel (21) moves in backward direction due to reduced pressure of the vacuum(V) between the outer plunger barrel (22) and the inner plunger barrel (21). Since, the forceps-lock head (31) is firmly engaged within the conical cavity (66) of the
process to guide the user and to facilitate injection process in dark too. On pushing the
united plunger barrel (40) through the thumb-rest (23), the forceps-lock head (31) of the
plunger shaft (30) gently enters into the conical cavity (66) of the piston assembly (60)
and constitutes a single plunger unit (67) as shown in figure 7(f). As soon as the flaps
(32) pass through the central passage (13) of the flange ring (12), the forceps-lock head
(31) opens and gets engage firmly with the piston assembly (60) occupying the inner
space of the conical cavity (66). On further pushing the proximal end (69) of the single
plunger unit (67), the piston assembly (60) simultaneously pushes the fluid (53) in
forward direction, which is injected into the body through the hypodermic needle
(72). Just before the completion of the injection process, the proximal end (N) of the
piston assembly (60) comes in close contact of end tips of the plurality of horizontally
extended pins (86) of the cap (84) holding the needle holder (74) and the needle hub
(71), as shown in figure 7(g). On further pushing the single plunger unit (67) in forward
direction, the plurality of horizontally extended pins (86) begin sliding in forward
direction to dislodge the needle holder (74) from grip of the cap (84). At the same time,
the needle catch projection (65) of the piston assembly (60) also gently enters into the
conical cavity (75) of the needle hub (71) and gets engage therein to attach the
retractable needle assembly (70) with the help of the conical ridge (76) occupying the
conical groove (91) of the conical cavity (77) of the needle holder (74) as shown in figure
7(h).

At the end of the injection process, as shown in figure 7(h), the plurality of
horizontally extended pins (86) holding the needle hub (71) slide completely in forward
direction to dislodge the needle hub (71) along with the needle holder (74) from the
close contact of the cap (84). Simultaneously, the conical lock-notch (34) firmly
engaging the outer plunger barrel (22) to the inner plunger barrel (21) itself presses
inwardly, while axially passing through passage of the partition ring (11) in forward
direction. It unlocks and releases the outer plunger barrel (22) and consequently, the
inner plunger barrel (21) moves in backward direction due to reduced pressure of the
vacuum (V) between the outer plunger barrel (22) and the inner plunger barrel (21).
Since, the forceps-lock head (31) is firmly engaged within the conical cavity (66) of the
piston assembly (60) and the piston assembly (60) itself is engaged with the retractable needle assembly (70) through engagement of the needle catch projection (65) with the conical cavity (75) of the needle hub (71), movement of the inner plunger barrel (21) in the backward direction gently retracts the hypodermic needle (72) along with the needle holder (74) holding the needle hub (71) due to the reduced pressure of the vacuum (V), as shown in figure 7(i).

Also, the first spring of the plunger assembly (20) may help in the backward movement of the inner plunger barrel (21) along with the hypodermic needle (72). The first spring is compressed when the outer plunger barrel (22) is pulled out at its full length to constitute the united plunger barrel (40) and the vacuum (V) is created between the inner plunger barrel (21) and the outer plunger barrel (22). As soon as the outer plunger barrel (22) is unlocked from the conical lock-notch (34) at the end of the injection process, compression of the first spring is gradually released which results in the backward movement of the inner plunger barrel (21) along with the hypodermic needle (72). Further, combination of both the vacuum (V) and the first spring may help in the backward movement of the inner plunger barrel (21) along with the hypodermic needle (72).

As shown in figure 7(j), during the movement of the inner plunger barrel (21) in the backward direction, the flaps (32) pass through the central passage (13) of the flange ring (12) and press inwardly resulting in closure of the forceps-lock head (31), releasing itself from the conical cavity (66) of the piston assembly (60), leaving behind the hypodermic needle (72) encapsulated within an empty fluid-cartridge (B). Thus, the inner plunger barrel (21) along with plunger shaft (30) attains its initial state soon after the vacuum (V) between the inner plunger barrel (21) and the outer plunger barrel (22) is completely released. As soon as the injection process completes, the LED indicator (42) gets switched off indicating the completion of the injection process.

As shown in figure 7(k), the empty fluid-cartridge (B) encapsulating the hypodermic needle (72) is detached from the injector (A) to dispose of safely, whereas
the injector (A) finally attains its original state to become ready for next operation. Further, the needle guard (85) may be inserted on the retracted hypodermic needle (72) in the empty fluid-cartridge (B) as shown in figure 7(f).

Figure 8 (a) illustrates the injector (A) having the needle shaped plunger shaft (38) and the fluid-cartridge (B) as shown in figure 4(b’) of the fluid injecting system (100) in accordance with another embodiment of the present invention. Prior to the injection process, the distal end (M) of the fluid container (50) of the fluid-cartridge (B) is attached at the proximal end (P) of the injector (A) through the inner engagement means (14b) of the injector body (10) to the engagement means (14a’) of the fluid container (50) to constitute the fluid injecting system (100) as shown in figure 8(b).

As shown in figure 8(c), the LED indicator (42) gets switched on as soon as the outer plunger barrel (22) is pulled out at its full length to constitute the united plunger barrel (40) retaining the vacuum (V) between the inner plunger barrel (21) and the outer plunger barrel (22) and the LED indicator (42) illuminates the end tip of the hypodermic needle (72) and surrounding area of the injectable site. On pushing the united plunger barrel (40) through the thumb-rest (23) the needle shaped plunger shaft (38) pierces the rubber cap (39) provided on the distal end (M) of the fluid-container (50) and gently enters into the conical cavity (66) of the piston assembly (60) as shown in figure 8(d). On further pushing the united plunger barrel (40), the needle shaped plunger shaft (38) presses the piston assembly (60) in forward direction, which simultaneously pushes the fluid (53) along with the retractable needle assembly (70) in forward direction until the hypodermic needle (72) extends out through the opened conical mouth (51) of the fluid container (50) and the needle hub (71) settles inside the fluid container (50) at the proximal end (M’) of the fluid container (50). As soon as the piston assembly (60) moves in forward direction and goes apart from the rubber cap (39), a vacuum (V’) is generated between the piston assembly (60) and the rubber cap (39), as shown in figure 8(e). Further, the needle guard (85) is removed from the hypodermic needle (72) to expose the hypodermic needle (72).
As shown in figure 8(f), on further pushing the united plunger barrel (40) in forward direction, the conical cavity (75) of the needle hub (71) attaches with the needle catch projection (65) of the piston assembly (60) of the fluid-cartridge (B). Just before the completion of the injection process, the proximal end (N) of the piston assembly (60) comes in close contact of the end tips of the plurality of horizontally extended pins (86) of the cap (84) holding the needle hub (71), which begins sliding in forward direction and separates the retractable needle assembly (70) from the needle hub (71). At this stage the U-clip locking means (35) of the injector (A) is pressed inwardly which unlocks the inner plunger barrel (21) from the outer plunger barrel (22) and results in backward movement of the inner plunger barrel due to release of the vacuum (V) between the inner plunger barrel (21) and the outer plunger barrel (22) and thereafter, the inner plunger barrel (21) comes at its initial state as shown in figure 8(g). As soon as the injection process completes, the LED indicator (42) gets switched off indicating the completion of the injection process.

Further, as shown in figure 8(g), the vacuum (V') remains between the rubber cap (39) and the piston assembly (60) holding the hypodermic needle (72) even after withdrawal of the needle hub (71) from the retractable needle assembly (70). This vacuum (V') results in retraction of the hypodermic needle (72) along with the piston assembly (60) in backward direction and the hypodermic needle (72) is finally encapsulated within the empty fluid-cartridge (B) as shown in figure 8(h).

As shown in figure 8(i) the empty fluid-cartridge (B) containing encapsulated hypodermic needle (72) is detached from the injector (A) to dispose of safely whereas the injector (A) finally attains its original state to become ready for next operation.

Figure 9(a) illustrates the injector (A) and the fluid-cartridge (B) as shown in figure 5(a) of the fluid injecting system (100) in accordance with yet another embodiment of the present invention. Prior to the injection process, the distal end (M) of the fluid container (50) of the fluid-cartridge (B) is attached at the proximal end (P) of the injector (A) through the inner engagement means (14b) of the injector body (10) to the
engagement means (14a') of the fluid container (50) to constitute the fluid injecting system (100), as shown in figure 9(b). Further, the fluid-cartridge (B) is configured to have the cylindrical saw blade (59) at the proximal end (N) of the piston assembly (60) of the fluid-cartridge (B). The cylindrical saw blade (59) surrounds the needle catch projection (65) of the piston assembly (60) of the fluid-cartridge (B), and is provided with a hole passage (58) as shown in figure 9(c) (i), (ii) and (iii).

As shown in figure 9(d), the needle guard (85) along with the hypodermic needle (72) is drawn out by the user, which facilitates the hypodermic needle (72) along with the needle guard (85) to extend out through the opened conical mouth (51) of the fluid container (50) and the needle holder (74) click fits with the needle hub (71). Thereafter, the needle guard (85) is rotated in the anticlockwise direction by 90 degrees to unlock the locking means (90) and drawn out to remove the needle guard (85) to expose the hypodermic needle (72) as shown in figure 9(e).

As shown in figure 9(f), the LED indicator (42) gets switched on as soon as the vacuum (V) is generated in the united plunger barrel (40) and illuminates the end tip of the hypodermic needle (72) and surrounding area of the injectable site to facilitate injection in dark also. On pushing the united plunger barrel (40) through the thumb-rest (23) the forceps-lock head (31) of the plunger shaft (30) gently enters into the conical cavity (66) of the piston assembly (60) and constitutes the single plunger unit (67) as shown in figure 9(g). On further pushing the single plunger unit (67), the piston assembly (60) simultaneously pushes the fluid (53) in forward direction, which is injected into the body through the hypodermic needle (72) as shown in figure 9(h).

As shown in figure 9(h), the circular O-ring (79) having the needle holder (74) at center is provided at the proximal end (M) of the fluid container (50). The circular O-ring (79) is further provided with the thin layer circular diaphragm (57) between the circular O-ring (79) and the needle holder (74). A diameter of an inner-edge of the thin layer circular diaphragm (57) is slightly lesser than an inner diameter of the cylindrical saw blade (59), whereas a diameter of an outer-edge of the thin layer circular diaphragm (57) is slightly greater than an outer diameter of the cylindrical saw blade (59), so that
the cylindrical saw blade (59) may conveniently cut the thin layer of circular diaphragm (57) and hold the needle holder (74) firmly at the end of the injection process. Further, the retractable needle assembly (70) comprises the needle hub (71) containing the hypodermic needle (72) encapsulated within the needle guard (85) through the locking means (90).

On further pushing the single plunger unit (67) in forward direction, as shown in figure 9(i), the cylindrical saw blade (59) cuts the thin layer circular diaphragm (57) and holds the needle holder (74) at the end of the injection process. At the same time, the needle catch projection (65) of the piston assembly (60) also enters into the conical cavity (75) of the needle hub (71) and gets engage therein to attach the retractable needle assembly (70). Simultaneously, the conical lock-notch (34) firmly engaging the outer plunger barrel (22) to the inner plunger barrel (21) itself presses inwardly, while axially passing through passage of the partition ring (11) in forward direction. It unlocks and releases the outer plunger barrel (22) and consequently, the inner plunger barrel (21) moves in backward direction due to reduced pressure of the vacuum (V) between the outer plunger barrel (22) and the inner plunger barrel (21) as shown in figure 9(i). Further, the movement of the inner plunger barrel (21) in the backward direction gently retracts the hypodermic needle (72) along with the needle holder (74) holding the needle hub (71) due to the reduced pressure of the vacuum (V).

As shown in figure 9(k), during the movement of the inner plunger barrel (21) in the backward direction, the flaps (32) pass through the central passage (13) of the flange ring (12) and press inwardly resulting in closure of the forceps-lock head (31), releasing itself from the conical cavity (66) of the piston assembly (60), leaving behind the hypodermic needle (72) encapsulated within the empty fluid-cartridge (B). Thus, the inner plunger barrel (21) along with plunger shaft (30) attains its initial state soon after the vacuum (V) is completely released. As soon as the injection process completes, the LED indicator (42) gets switched off indicating the completion of the injection process.

As shown in figure 9(l), the empty fluid-cartridge (B) encapsulating the
hypodermic needle (72) is detached from the injector (A) to dispose safely, whereas the injector (A) finally attains its original state to become ready for next operation. Further, the needle guard (85) may be inserted on the retracted hypodermic needle (72) in the empty fluid-cartridge (B), as shown in figure 9(m).

Figure 10 illustrates the injector (A) and the fluid-cartridge (B) as shown in figure 6(a) of the fluid injecting system (100) in accordance with yet another embodiment of the present invention. Prior to the injection process, the distal end (M) of the fluid container (50) of the fluid-cartridge (B) is attached at the proximal end (P) of the injector (A) through the inner engagement means (14b) of the injector body (10) to the engagement means (14a') of the fluid container (50) to constitute the fluid injecting system (100).

As shown in figure 10, the piston assembly (60) of the fluid-cartridge (B) is configured to have a circular ridge projection (64) at rim of the piston flange (61) at a proximal end (Q) of the piston flange (61) of the piston assembly (60). The circular ridge projection (64) is having a width equal to a width of the O-ring (79) of the retractable needle assembly (70) at a distal end (S') of the O-ring (79). The needle holder (74) of the retractable needle assembly (70) is provided with a flange rim (54) which is further provided with a collar projection (55) at a distal end (X') of the needle holder (74) to hold the O-ring (79) firmly between the flange rim (54) and the interior of the fluid container (B). The O-ring (79) is having a width, inner and outer diameter at the distal end (S') equal to the width, inner and outer diameter of the circular ridge projection (64) at a proximal end (W) of the circular ridge projection (64). Also, the inner diameter of the O-ring (79) at a proximal end (W) of the O-ring (79) is greater than the inner diameter of the O-ring at the distal end (S') of the O-ring (79) to allow convenient seating of the O-ring (79) around the collar projection (55) of the flange rim (54). Further, the operation of the fluid injecting system (100) has been described in earlier embodiments and therefore, the same has not been discussed here for the sake of brevity. Furthermore, the retraction mechanism of the hypodermic needle (72) is different from the other embodiments in which just before the completion of the injection process, the circular
ridge projection (64) pushes the O-ring (79) in forward direction to disengage the O-ring (79) from the flange rim (54) of the needle holder (74) resulting in release of the needle holder (74). Thereafter, movement of the inner plunger barrel (21) in the backward direction, as explained in previous embodiments, gently retracts the hypodermic needle (72) along with the needle holder (74) holding the needle hub (71) in the empty fluid-cartridge (B) due to the reduced pressure of the vacuum (V). Also, the injector (A) finally attains its original state to become ready for next operation.

Figure 11 illustrates a perspective view of a fluid collector (200) in accordance with an embodiment of the present invention. As shown in figure 11, the fluid collector (200) comprises a fluid container (50'), a piston assembly (60') and a container cover (80). Further, the fluid collector (200) is releasably engaged with the injector (A) at the proximal end (P) of the injector (A).

In accordance with an embodiment of the present invention, the fluid container (50') is a uniformly regular and hollow cylindrical body having a centrally extended conical projection (70') containing a needle holder (71') at a proximal end (C') of the conical projection (70') to hold a detachable hypodermic needle (72'). A distal end (E') of the fluid container (50') is covered with a thin layer of diaphragm (52). Further, the fluid container (50') is provided with engagement means (14a', 14b') at the distal end (E') to firmly engage with the inner engagement means (14b) and the outer engagement means (14a) provided at the proximal end (P') of the injector body (10).

In accordance with an embodiment of the present invention, the piston assembly (60') comprises a piston flange (61') provided with a conical cavity (66') at center of the piston assembly (60') at a distal end (D') of the piston assembly (60') to receive and retain the forceps-lock head (31) of the plunger shaft (30) of the injector (A) during the fluid collection process. The thin layer of diaphragm (52) of the fluid container (50') is pierced by the forceps-lock head (31) and thereafter the forceps-lock head (31) enters into the conical cavity (66') of the piston assembly (60'). The conical cavity (66') is having an opening diameter lesser than an inner diameter of the conical cavity (66') to
receive and firmly engage with the opened forceps-lock head (31) of the plunger shaft (30) of the injector (A). Further, the opening diameter of the conical cavity (66') is greater than an outer diameter of the closed forceps-lock head (31) of the plunger shaft (30) to receive the closed forceps-lock head (31) conveniently. Also, a rim of the piston flange (61') is provided with a plurality of grooves (62') to hold a piston seal (63') between the piston flange (61') and the fluid container (50').

In accordance with an embodiment of the present invention, the container cover (80) is a uniformly regular and hollow cylindrical body having an open mouth at a distal end (F'). The container cover (80) is having an internal diameter slightly higher than an outer diameter of the fluid container (50') at a proximal end (G') of the fluid container (50') to firmly hold the fluid container (50') to fixedly cover it. Further, the container cover (80) is internally provided with a concave diaphragm (81) in middle of the container cover (80) facing towards the open mouth at the distal end (F') of the container cover (80). Furthermore, the container cover (80) is removably attached with the fluid container (50'). The concave diaphragm (81) is having a central hole (82) at center of the concave diaphragm (81). The central hole (82) is configured to have a diameter less than a detachable needle hub (78).

In accordance with an embodiment of the present invention, the concave diaphragm (81) is divided into a plurality of equal parts constituting respective number of flaps, which are configured to be pressed only towards bottom of the container cover (80) to increase size of the central hole (82) to allow entry of a rim of the detachable hypodermic needle (72'). Further, the central hole (82) does not allow the detachable hypodermic needle (72') to retract in backward direction.

In accordance with an embodiment of the present invention, the container cover (80) is firmly attached with the fluid container (50') by way of a removable ring seal (83) between the fluid container (50') and the container cover (80) to cover the proximal end (G') of the fluid container (50').
The schematic details of operation of the fluid collector (200) coupled with the injector (A) are shown in figure 12(a) to figure 12(c).

Figure 12(a) illustrates the fluid collector (200) and the injector (A) in accordance with an embodiment of the present invention. Prior to the fluid collection process, the fluid collector (200) is conveniently attached at the proximal end (P) of injector (A) through the engagement means (14a') provided at the distal end (E') of the fluid container (50') to firmly engage with the inner engagement means (14b) provided at the proximal end (P') of the injector body (10) to constitute a united assembly of the injector (A) and the fluid collector (200) as shown in figure 12(b). Further, the removable ring seal (83) is removed from the fluid container (50') as shown in figure 12(c).

As shown in figure 12(d), the outer plunger barrel (22) of the injector (A) is withdrawn in backward direction unless the interiorly protruded flange rim (24) passes over the conical lock-notch (34) of the U-clip locking means (35) and gets engage at the distal end (G) of the inner plunger barrel (21) to combine the inner plunger barrel (21) and the outer plunger barrel (22) in order to constitute the united plunger barrel (40). During this process, the vacuum (V) is generated between the inner plunger barrel (21) and the outer plunger barrel (22). The LED indicator (42) gets switched on as soon as the vacuum (V) is generated in the united plunger barrel (40) and illuminates the end tip of the hypodermic needle (72).

As shown in figure 12(e), the container cover (80) is removed from the fluid container (50') and thereafter, the detachable hypodermic needle (72') is pierced conveniently into a source of fluid or the target.

As shown in figure 12(f), the united plunger barrel (40) is pushed in forward direction through the thumb-rest (23) due to which the forceps-lock head (31) of the plunger shaft (30) of the injector (A) gently enters into the fluid collector (200) piercing through the thin layer of diaphragm (52) of the fluid container (50') with the help of sharp-edged blades provided at the proximal end (K') of the flaps (32). After piercing the
thin layer of diaphragm (52) the forceps-lock head (31) enters into the conical cavity (66') of the piston assembly (60'), where the forceps-lock head (31) is firmly retained by the conical cavity (66') as shown in figure 12(g). At this stage, the conical lock-notch (34) of the U-clip locking means (35) firmly engaging the outer plunger barrel (22) with the inner plunger barrel (21) itself presses inwardly while axially passing through the passage of the partition ring (11) in forward direction. It unlocks and releases the outer plunger barrel (22) and facilitates retraction of the inner plunger barrel (21) along with the piston assembly (60') of the fluid collector (200) resulting in aspiration of the fluid from the source of the fluid through the passage of detachable hypodermic needle (72') and collects the fluid into the fluid container (50') as shown in figure 12(h).

As shown in figure 12(i), when the flaps (32) of the plunger shaft (30) pass through a flange ring (95) containing the thin layer of diaphragm (52), the forceps-lock head (31) gets closed being pressed inwardly resulting in detachment of the forceps-lock head (31) from the conical cavity (66') of the piston assembly (60') of the fluid collector (200). Thus, a fixed volume of the fluid is stored in the fluid collector (200). As soon as the vacuum (V) between the inner plunger barrel (21) and the outer plunger barrel (22) is completely released, the inner plunger barrel (21) attains its initial original position to hold the united plunger barrel (40), as shown in figure 12(j). As soon as the fluid collection process completes, the LED indicator (42) gets switched off indicating the completion of the fluid collection process.

The push-button (43) of the injector (A) may be used to regulate, control or restrict the movement of retracting united plunger barrel (40) under the influence of the reduced pressure between the inner plunger barrel (21) and the outer plunger barrel (22). On pressing the push-button (43), it restricts the movement of the united plunger barrel (40) in backward direction and allows the retraction when the push-button (43) is left un-pressed.

As shown in figure 12(k), the detachable hypodermic needle (72') is gently withdrawn from the source of fluid and is covered by the container cover (80). While
covering with the container cover (80), rim of the detachable hypodermic needle (72') presses the flaps of the concave diaphragm (81) in forward direction to increase diameter of the central hole (82), so as to allow passage of the detachable hypodermic needle rim across the central hole (82). On completion of covering process, the flaps of concave diaphragm (81) retain initial state. The fluid collector (200) containing the fluid may now be conveniently separated from the injector (A) as shown in figure 12(l).

In accordance with an embodiment of the present invention, the fluid stored in the fluid collector (200) is further processed. For the processing of the fluid, the collected fluid needs be withdrawn from the fluid collector (200) which is conveniently and efficiently performed by the injector (A) itself.

As shown in figure 12(m), the fluid collector (200) containing the stored fluid is again attached with the injector (A). Further, the attachment of the fluid collector (200) and the injector (A) has been described earlier and therefore, the same has not been discussed here for the sake of brevity.

As shown in figure 12(n), the container cover (80) is removed by drawing out it in forward direction. During this process, the detachable hypodermic needle (72') is detached and separated from the detachable needle holder (71') as diameter of the central hole (82) of concave diaphragm (81) being lesser than the rim of the detachable hypodermic needle (72') does not allow the detachable hypodermic needle (72') to move in backward direction and results in detachment of the detachable hypodermic needle (72') from the fluid container (50'). The detachable hypodermic needle (72') finally and safely remains inside the container cover (80) and becomes non-reusable. Further, a fresh hypodermic needle may be attached with the fluid container (50') to repeat the whole process to liberate out the fluid contents in desired volume as per the requirements.

As shown in figure 12(o), after complete discharging of the fluid from the fluid collector (200), empty fluid collector (200) may again be covered by fixing the container
cover (80) to safely dispose-off the empty fluid collector (200) after detaching it from the injector (A).

A uniform cylindrical hollow barrel ring (49) of appropriate length, as shown in figure 13(a) may be inserted in the fluid collector (200) through the distal end (E') of the fluid container (50') to ensure collection of predefined volume of the fluid. An outer diameter of the cylindrical hollow barrel ring (49) is equal to the inner diameter of the fluid container (50'), whereas an inner diameter of the cylindrical hollow barrel ring (49) is equal to an inner diameter of the flange ring (12) of the injector (A). Further, length of the cylindrical hollow barrel ring (49) is lesser than the length of the fluid contained as per the requirement needed to collect the appropriate/desired pre-defined volume of the fluid. On inserting the cylindrical hollow barrel ring (49) in the fluid container (50') through the distal end (E'), it slides the flange ring (95) containing the thin layered diaphragm (52) in forward direction to reduce space in the fluid container (50') to collect the pre-defined volume of the fluid as shown in figure 13 (b) and (c).

Figure 14 is a flow chart illustrating a fluid injecting method (300) in accordance with an embodiment of the present invention.

At step 302, as shown in figure 14, the fluid-cartridge (B) having the fluid (53) sandwiched between the piston assembly (60) and the retractable needle assembly (70) of the fluid-cartridge (B) is provided. Further, the fluid (53) is an injectable fluid.

At step 304, the fluid-cartridge (B) is reversibly coupled with the injector (A) having the plunger shaft (30) and the united plunger barrel (40). Also, the injector (A) is having the inner plunger barrel (21) slidable within the outer plunger barrel (22). Further, the fluid-cartridge (B) is reversibly coupled with the injector (A) at the proximal end (P) of the injector (A).

In accordance with an embodiment of the present invention, the united plunger barrel (40) is formed by pulling out the outer plunger barrel (22) completely. Further, the
united plunger barrel (40) is configured to retain the vacuum (V) between the inner plunger barrel (21) and the outer plunger barrel (22).

In other words, the outer plunger barrel (22) is pulled out at its full length which results in a reversible engagement of the outer plunger barrel (22) with the locking means (35) of the inner plunger barrel (21) and restricts movement of the outer plunger barrel (22) in the forward direction and forms the united plunger barrel (40).

In accordance with an embodiment of the present invention, the injector (A) is configured for actuating an axial movement of the plunger shaft (30) in the forward direction and in a backward direction for retracting the plunger shaft (30).

At step 306, the united plunger barrel (40) is pushed in the forward direction to deliver the fluid (53) from the fluid-cartridge (B) into the injectable site. Further, the retractable needle assembly (70) of the fluid-cartridge (B) is retracted within the empty fluid-cartridge (B) due to release of the vacuum (V) after completion of the injection process.

In accordance with an embodiment of the present invention, the movement of the inner plunger barrel (21) in the backward direction gently retracts the retractable needle assembly (70) into the empty fluid-cartridge (B) and thereafter, the inner plunger barrel (21) attains its initial state.

Figure 15 is a flow chart illustrating a fluid collecting method (400) in accordance with an embodiment of the present invention.

At step 402, the fluid collector (200) having the piston assembly (60') and the detachable hypodermic needle (72') is provided. Further, the detachable hypodermic needle (72') is covered by the container cover (80).

At step 404, the fluid collector (200) is reversibly coupled with the injector (A). The injector (A) is having the plunger shaft (30) and the united plunger barrel (40). Also,
the injector (A) is having the inner plunger barrel (21) slidable within the outer plunger barrel (22). Further, the fluid collector (200) is reversibly coupled with the injector (A) at the proximal end (P) of the injector (A).

In accordance with an embodiment of the present invention, the united plunger barrel (40) is formed by pulling out the outer plunger barrel (22) completely. Further, the united plunger barrel (40) is configured to retain the vacuum (V) between the inner plunger barrel (21) and the outer plunger barrel (22).

In accordance with an embodiment of the present invention, the injector (A) is configured for actuating the axial movement of the plunger shaft (30) in the forward direction and in the backward direction for retracting the plunger shaft (30).

At step 406, the container cover (80) is removed from the fluid collector (200) to expose the detachable hypodermic needle (72').

In accordance with an embodiment of the present invention, the removable ring seal (83) is removed from the fluid collector (200) in order to separate the container cover (80) from the fluid collector (200).

At step 408, the detachable hypodermic needle (72') is inserted into a target fluid source.

In accordance with an embodiment of the present invention, the step 408 further comprises a step of pushing the united plunger barrel (40) in the forward direction to attach the plunger shaft (30) of the injector (A) with the piston assembly (60') of the fluid collector (200).

At step 410, the fluid from the target fluid source is collected into the fluid collector (200).
In accordance with an embodiment of the present invention, the release of the vacuum (V) results in the backward movement of the inner plunger barrel (21) along with the plunger shaft (30) and the piston assembly (60°) which leads to the suction of the fluid from the target fluid source through the passage of detachable hypodermic needle (72°) and collects the fluid into the fluid collector (200).

The above-mentioned fluid injecting system and method thereof overcomes the problems and shortcomings of the existing hypodermic syringes having retractable needles and provides a number of advantages over them. The fluid injecting system is having the injector and the fluid-cartridge and is capable of retracting the hypodermic needle by virtue of self-generated vacuum and encapsulates the hypodermic needle in retracted position within the fluid-cartridge after completion of the injection process. Further, the fluid-cartridge encapsulating the retracted needle becomes non-reusable. Also, the injector of the fluid injecting system is reusable. The fluid injecting system is economical and user friendly and avoids applying additional force to activate the retraction mechanism for retraction of the hypodermic needle. The retraction of the hypodermic syringe may be performed with or without the first spring. In addition, the proposed fluid injecting system provides an advantage of performing the injection process in dark also and patients will also be aware of the injection process as the LED indicator gets switched off after the completion of the injection process.

The exemplary implementation described above is illustrated with specific shapes, dimensions, and other characteristics, but the scope of the invention includes various other shapes, dimensions, and characteristics. Also, the fluid injecting system as described above could be designed and fabricated in various other ways and could include various other materials and various other fluid-cartridge, fluid container, hypodermic needle etc.

Various modifications to these embodiments are apparent to those skilled in the art from the description and the accompanying drawings. The principles associated with the various embodiments described herein may be applied to other embodiments.
Therefore, the description is not intended to be limited to the embodiments shown along with the accompanying drawings but is to be providing broadest scope of consistent with the principles and the novel and inventive features disclosed or suggested herein. Accordingly, the invention is anticipated to hold on to all other such alternatives, modifications, and variations that fall within the scope of the present invention and appended claims.
We claim:

1. A fluid injecting system (100), comprising:
   an injector (A) having an injector body (10);
   a plunger shaft (30);
   a plunger assembly (20) having an inner plunger barrel (21) slideable within an outer plunger barrel (22), said inner plunger barrel (21) having a locking means (35) configured to restrict movement of said outer plunger barrel (22) in forward direction, said outer plunger barrel (22) and said inner plunger barrel (21) are configured to form a united plunger barrel (40) when said outer plunger barrel (22) is pulled out at its full length;
   a fluid-cartridge (B) having a fluid (53) and a hypodermic needle (72) for injecting said fluid (53) at an injectable site;
   wherein said fluid-cartridge (B) is configured to releasably engage with said injector (A) at a proximal end (P) of said injector (A);
   wherein a vacuum (V) is created between said outer plunger barrel (22) and said inner plunger barrel (21) upon formation of said united plunger barrel (40);
   wherein forward movement of said united plunger barrel (40) transfers said fluid (53) from said fluid-cartridge (B) into said injectable site;
   wherein said hypodermic needle (72) retracts within empty fluid-cartridge (B) due to release of said vacuum (V) and said injector (A) is disengaged from said fluid-cartridge (B) for reuse.

2. The fluid injecting system (100) as claimed in claim 1, wherein said injector body (10) comprises a partition ring (11) and a flange ring (12) at a proximal end (P) of said injector body (10) to hold said plunger shaft (30) in center of said injector body (10).

3. The fluid injecting system (100) as claimed in claim 1, wherein said injector body (10) further comprises a finger flange (15) at a distal end (D) of said injector body (10) for holding said injector (A) and an inner engagement means (14b) and an outer engagement means (14a) at a proximal end (P) of said injector body (10) to engage
4. The fluid injecting system (100) as claimed in claim 3, wherein said inner engagement means (14b) and said outer engagement means (14a) are L-shaped grooves.

5. The fluid injecting system (100) as claimed in claim 1, wherein said outer plunger barrel (22) of said plunger assembly (20) comprises a thumb-rest (23) at a distal end (E) and an interiorly protruded flange rim (24) at a proximal end (F) of said outer plunger barrel (22).

6. The fluid injecting system (100) as claimed in claim 5, wherein said thumb-rest (23) is having a rubber O-ring (28).

7. The fluid injecting system (100) as claimed in claim 5, wherein said interiorly protruded flange rim (24) is having an inner diameter equal to an outer diameter of said inner plunger barrel (21) of said plunger assembly (20).

8. The fluid injecting system (100) as claimed in claim 1, wherein said outer plunger barrel (22) of said plunger assembly (20) is having an outer diameter equal to an inner diameter of said injector body (10).

9. The fluid injecting system (100) as claimed in claim 1, wherein said inner plunger barrel (21) of said plunger assembly (20) comprises a piston seal holder (25) at a distal end (G) of said inner plunger barrel (21) of said plunger assembly (20) to hold a piston seal (26) between exterior of said inner plunger barrel (21) and interior of said outer plunger barrel (22).

10. The fluid injecting system (100) as claimed in claim 1, wherein said plunger shaft (30) is configured to have an axially furrowed forceps-lock head (31) containing two outwardly protruded flaps (32).
11. The fluid injecting system (100) as claimed in claim 10, wherein said two outwardly protruded flaps (32) are configured to be sharp-edged blades at a proximal end (K') of said two outwardly protruded flaps (32).

12. The fluid injecting system (100) as claimed in claim 1, wherein said plunger shaft (30) is a needle shaped plunger shaft (38).

13. The fluid injecting system (100) as claimed in claim 1, wherein said locking means (35) is housed inside said inner plunger barrel (21).

14. The fluid injecting system (100) as claimed in claim 13, wherein said locking means (35) having a conical lock-notch (34) which protrudes out through a longitudinal slot (36) provided at said inner plunger barrel (21).

15. The fluid injecting system (100) as claimed in claim 14, wherein said locking means (35) is U-clip locking means.

16. The fluid injecting system (100) as claimed in claim 1, wherein said plunger assembly (20) is housed inside a distal chamber (a) of said injector (A) and said plunger shaft (30) is housed axially at center of a proximal chamber (b) of said injector (A).

17. The fluid injecting system (100) as claimed in claim 1, wherein said plunger assembly (20) is configured to have a first spring.

18. The fluid injecting system (100) as claimed in claim 17, wherein said first spring is provided between exterior of said inner plunger barrel (21) and interior of said outer plunger barrel (22) of said plunger assembly (20).

19. The fluid injecting system (100) as claimed in claim 1, wherein said
inner plunger barrel (21) is provided with plurality of button cells (41) and a LED indicator (42).

20. The fluid injecting system (100) as claimed in claim 19, wherein said inner plunger barrel (21) is provided with a plurality of intrusions to hold a plurality of metallic strips to form a LED circuit.

21. The fluid injecting system (100) as claimed in claim 1, wherein said injector (A) is configured to have a push-button (43) provided at a septum (44) at said proximal end (P) of said injector (A).

22. The fluid injecting system (100) as claimed in claim 21, wherein said push-button (43) is provided with a second spring (45).

23. The fluid injecting system (100) as claimed in claim 1, wherein said fluid (53) is an injectable fluid.

24. The fluid injecting system (100) as claimed in claim 1, wherein said fluid-cartridge (B) further comprises:
   a fluid container (50) having a distal end (M) and a proximal end (M') and configured to contain said fluid (53);
   a piston assembly (60) having a piston flange (61) and a conical cavity (66) configured to engage said plunger shaft (30);
   a retractable needle assembly (70) having a needle hub (71) configured to hold said hypodermic needle (72), a needle holder (74) configured to hold said needle hub (71), an O-ring (79), a cap (84) having a plurality of horizontally extended pins (86) towards the distal end (M) of said fluid container (50) and a needle guard (85) configured to cover said hypodermic needle (72) disposed inside said fluid container (50);
   wherein said fluid container (50) comprises engagement means (14a', 14b') at said distal end (M) of said fluid container (50) to couple with said injector body (10).
wherein said proximal end (M') of said fluid container (50) is provided with a centrally opened conical mouth (51) to hold said needle hub (71);

wherein said plurality of horizontally extended pins (86) of said cap (84) are configured to pass through a plurality of clefts of said O-ring (79) to slidably hold said O-ring (79);

wherein said cap (84) is configured to hold said needle holder (74);

wherein said needle guard (85) is drawn out by a user allowing said hypodermic needle (72) along with said needle guard (85) to extend out of said needle holder (74);

wherein said united plunger barrel (40) of said injector (A) is pushed in forward direction to couple said plunger shaft (30) with said conical cavity (66) of said piston assembly (60) forming a single plunger unit (67);

wherein said single plunger unit (67) exerts a downward pressure on said fluid (53) for injecting said fluid (53) at said injectable site; and

wherein said single plunger unit (67) exerts a downward pressure on said plurality of horizontally extended pins (86) of said cap (84) for injecting remaining fluid (53) at said injectable site and releasing said needle holder (74) along with said hypodermic needle (72).

25. The fluid injecting system (100) as claimed in claim 24, wherein said engagement means (14a', 14b') are protrusions provided at both interior and exterior of said fluid container (50).

26. The fluid injecting system (100) as claimed in claim 24, wherein said piston flange (61) is configured to have a needle catch projection (65) at center of said piston assembly (60) at a proximal end (N') of said piston assembly (60).

27. The fluid injecting system (100) as claimed in claim 26, wherein said needle catch projection (65) is configured to have a conical ridge (68) at a proximal end (N') of said needle catch projection (65).

28. The fluid injecting system (100) as claimed in claim 27, wherein said needle catch projection (65) is configured to have a longitudinal furrow(F').
29. The fluid injecting system (100) as claimed in claim 27, wherein said needle catch projection (65) is configured to have a conical groove (Gr) at surface of said needle catch projection (65).

30. The fluid injecting system (100) as claimed in claim 24, wherein said piston flange (61) is configured to have plurality of grooves (62) to hold a piston seal (63) between said piston flange (61) and said fluid container (50).

31. The fluid injecting system (100) as claimed in claim 24, wherein said needle hub (71) comprises of a conical cavity (75) at a distal end (R) of said needle hub (71) to couple with said piston assembly (60).

32. The fluid injecting system (100) as claimed in claim 24, wherein said needle hub (71) holds said hypodermic needle (72) at center position at a proximal end (S) of said needle hub (71).

33. The fluid injecting system (100) as claimed in claim 32, wherein said needle hub (71) is configured to have a conical ridge (76) at said proximal end (S) of said needle hub (71).

34. The fluid injecting system (100) as claimed in claim 24, wherein said needle holder (74) is configured to have a conical cavity (77) with a conical groove (91) at a proximal end (T') of said needle holder (74).

35. The fluid injecting system (100) as claimed in claim 24, wherein said needle holder (74) and said needle hub (71) are configured to fuse together.

36. The fluid injecting system (100) as claimed in claim 24, wherein said needle guard (85) is configured to cover said hypodermic needle (72) using a locking means (90).
37. The fluid injecting system (100) as claimed in claim 36, wherein said needle guard (85) is configured to have a knob like structure (89) at a proximal end (X) of said needle guard (85).

38. The fluid injecting system (100) as claimed in claim 36, wherein said needle guard (85) is rotated in an anti-clockwise direction at a predetermined angle and drawn to separate from said hypodermic needle (72).

39. The fluid injecting system (100) as claimed in claim 38, wherein said predetermined angle is 90°.

40. The fluid injecting system (100) as claimed in claim 24, wherein said needle guard (85) is having an outer diameter equal to said centrally opened conical mouth (51) of said fluid container (50).

41. The fluid injecting system (100) as claimed in claim 24, wherein said fluid container (50) is configured to have a rubber cap (39) at said distal end (M) of said fluid container (50).

42. The fluid injecting system (100) as claimed in claim 24, wherein said piston assembly (60) is configured to have a cylindrical saw blade (59).

43. The fluid injecting system (100) as claimed in claim 24, wherein said retractable needle assembly (70) is configured to have a thin layer circular diaphragm (57) between said O-ring (79) and said needle holder (74).

44. The fluid injecting system (100) as claimed in claim 24, wherein said piston flange (61) is configured to have a circular ridge projection (84) at a proximal end (Q) of said piston flange (61).

45. The fluid injecting system (100) as claimed in claim 24, wherein said
needle holder (74) of said retractable needle assembly (70) is configured to have a flange rim (54) with a collar projection (55) at a distal end (X') of said needle holder (74) for holding said O-ring (79).

46. The fluid injecting system (100) as claimed in claim 45, wherein said O-ring (79) is having an inner diameter at a proximal end (W') of said O-ring (79) greater than an inner diameter of said O-ring (79) at a distal end (S') of said O-ring (79) to engage said O-ring (79) around said collar projection (55).

47. The fluid injecting system (100) as claimed in claim 24, wherein said hypodermic needle (72) extends out of said centrally open conical mouth (51) due to pressure exerted on said united plunger barrel (40).

48. The fluid injecting system (100) as claimed in claim 24, wherein said fluid (53) is sandwiched between said piston assembly (60) and said retractable needle assembly (70).

49. A fluid collector (200) configured to releasably engage with said injector (A) as claimed in claim 1, comprising:
   a fluid container (50') configured to have a centrally extended conical projection (70') containing a detachable needle holder (71') at a proximal end (C') of said conical projection (70') to hold a detachable hypodermic needle (72');
   a piston assembly (60') having a piston flange (61') provided with a conical cavity (66') at center of said piston assembly (60') at a distal end (D') of said piston assembly (60') to couple said plunger shaft (30) of said injector (A);
   a container cover (80) being internally provided with a concave diaphragm (81) having a central hole (82) to allow entry of said detachable hypodermic needle (72') along with a detachable needle hub (78);
   wherein said container cover (80) is removably attached with said fluid container (50').
wherein said fluid container (50') is provided with engagement means (14a', 14b') at said distal end (E') to engage with said injector body (10);

wherein said united plunger barrel (40) of said injector (A) retaining said vacuum (V) is pushed completely in forward direction to attach said plunger shaft (30) with said conical cavity (66') of said piston assembly (60'); and

wherein release of said vacuum (V) results in backward movement of said inner plunger barrel (21) of said united plunger barrel (40) along with said piston assembly (60') and in suction of a fluid from a target in said fluid container (50').

50. The fluid collector (200) as claimed in claim 49, wherein said fluid container (50') comprises a thin layer of diaphragm (52) at a distal end (E') of said fluid container (50').

51. The fluid collector (200) as claimed in claim 49, wherein said piston flange (61') is configured to have a plurality of grooves (62') to hold a piston seal (63') between said piston flange (61') and said fluid container (50').

52. The fluid collector (200) as claimed in claim 49, wherein said container cover (80) is having an internal diameter higher than an outer diameter of said fluid container (50') at a proximal end (G') of said fluid container (50') to attach with said fluid container (50').

53. The fluid collector (200) as claimed in claim 52, wherein said container cover (80) is attached with said fluid container (50') by way of a removable ring seal (83) to cover said proximal end (G') of said fluid container (50').

54. The fluid collector (200) as claimed in claim 49, wherein said concave diaphragm (81) is provided in middle of said container cover (80).

55. The fluid collector (200) as claimed in claim 49, wherein said central hole (82) is configured to have a diameter less than said detachable needle hub (78).
56. The fluid collector (200) as claimed in claim 49, wherein said concave diaphragm (81) is divided into a plurality of equal parts which are configured to be pressed only towards bottom of said container cover (80) to increase size of said central hole (82) to allow entry of said detachable hypodermic needle (72') along with said detachable needle hub (78).

57. A fluid injecting method (300), comprising the steps of:
   providing (302) a fluid-cartridge (B) having a fluid (53) sandwiched between a piston assembly (60) and a retractable needle assembly (70) of said fluid-cartridge (B);
   reversibly coupling (304) said fluid-cartridge (B) with an injector (A) having a plunger shaft (30) and a united plunger barrel (40); and
   pushing (306) said united plunger barrel (40) in a forward direction to deliver said fluid (53) from said fluid-cartridge (B) into an injectable site.

58. The fluid injecting method (300) as claimed in claim 57, wherein said injector (A) having an inner plunger barrel (21) slidable within an outer plunger barrel (22) and said united plunger barrel (40) is formed by pulling out said outer plunger barrel (22) completely.

59. The fluid injecting method (300) as claimed in claim 58, wherein said united plunger barrel (40) is configured to retain a vacuum (V) between said inner plunger barrel (21) and said outer plunger barrel (22).

60. The fluid injecting method (300) as claimed in claim 57, wherein said injector (A) is configured for actuating an axial movement of said plunger shaft (30) in said forward direction and in a backward direction for retracting said plunger shaft (30).

61. The fluid injecting method (300) as claimed in claim 57, wherein said fluid (53) is an injectable fluid.
62. The fluid injecting method (300) as claimed in claim 57, wherein said fluid-cartridge (B) is reversibly coupled with said injector (A) at a proximal end (P) of said injector (A).

63. A fluid collecting method (400), comprising the steps of:
   providing (402) a fluid collector (200) having a piston assembly (60') and a detachable hypodermic needle (72') covered by a container cover (80);
   reversibly coupling (404) said fluid collector (200) with an injector (A) having a plunger shaft (30) and a united plunger barrel (40);
   removing (406) said container cover (80) from said fluid collector (200) to expose said detachable hypodermic needle (72');
   inserting (408) said detachable hypodermic needle (72') into a target fluid source;
   collecting (410) a fluid from said target fluid source into said fluid collector (200).

64. The fluid collecting method (400) as claimed in claim 63, wherein said step of inserting (408) further comprises a step of pushing said united plunger barrel (40) in a forward direction to attach said plunger shaft (30) of said injector (A) with said piston assembly (60') of said fluid collector (200).

65. The fluid collecting method (400) as claimed in claim 63, wherein said injector (A) having an inner plunger barrel (21) slidable within an outer plunger barrel (22) and said united plunger barrel (40) is formed by pulling out said outer plunger barrel (22) completely.

66. The fluid collecting method (400) as claimed in claim 65, wherein said united plunger barrel (40) is configured to retain a vacuum (V) between said inner plunger barrel (21) and said outer plunger barrel (22).

67. The fluid collecting method (400) as claimed in claim 63, wherein said injector (A) is configured for actuating an axial movement of said plunger shaft (30) in a
forward direction and in a backward direction for retracting said plunger shaft (30).

68. The fluid collecting method (400) as claimed in claim 63, wherein said fluid collector (200) is reversibly coupled with said injector (A) at a proximal end (P) of said injector (A).
FIG. 7(k)

FIG. 7(l)
FIG. 8(c)

FIG. 8(d)
FIG. 9(c)
300

- Providing a fluid-cartridge

304

- Reversibly coupling the fluid-cartridge with an injector

306

- Pushing the united plunger barrel to deliver the fluid

FIG. 14
FIG. 15

400

Providing a fluid collector

402

Reversibly coupling the fluid collector with an injector

404

Removing a container cover to expose a detachable hypodermic needle

406

Inserting the detachable hypodermic needle in a target fluid source

408

Collecting a fluid from the target fluid source

410
INTERNATIONAL SEARCH REPORT BY
EUROPEAN PATENT OFFICE

PATENT COOPERATION TREATY
PCT

INTERNATIONAL SEARCH REPORT
(PCT Article 18 and Rules 43 and 44)

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<td>FPT0086</td>
<td>see Form PCT/ISA/220 as well as, where applicable, item 5 below.</td>
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<th>International filing date (day/month/year)</th>
<th>(Earliest) Priority Date (day/month/year)</th>
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Applicant
RATHORE, JAI HIND

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 6 sheets. It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report
   a. With regard to the language, the international search was carried out on the basis of:
      - the international application in the language in which it was filed
      - a translation of the international application into ____________ (which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

   b. ☐ This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6(b)(a)).
   c. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☒ Certain claims were found unsearchable (See Box No. II)

3. ☒ Unity of Invention is lacking (see Box No. III)

4. With regard to the title,
   - the text is approved as submitted by the applicant
   - ☐ the text has been established by this Authority to read as follows:
     A FLUID INJECTING SYSTEM WITH NEEDLE RETRACTION BY VACUUM

5. With regard to the abstract,
   - ☒ the text is approved as submitted by the applicant
   - ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the drawings,
   a. the figure of the drawings to be published with the abstract is Figure No. 1
      - ☒ as suggested by the applicant
      - ☐ as selected by this Authority, because the applicant failed to suggest a figure
      - ☐ as selected by this Authority, because this figure better characterizes the invention
   b. ☐ none of the figures is to be published with the abstract
INTERNATIONAL SEARCH REPORT

Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. X Claims No.: 57-68
   because they relate to subject matter not required to be searched by this Authority, namely:
   see FURTHER INFORMATION sheet PCT/ISA/210

2. [ ] Claims No.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims No.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invoke payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.: 

4. X No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-48

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

Form PCT/ISA210 (continuation of first sheet (2)) (April 2005)
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
   INV. A61M5/32
   ADD. A61M5/24

   According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
   Minimum documentation searched (classification system followed by classification symbols)
   A61M

   Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

   Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
   EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>A</td>
<td>WO 2014/080420 A2 (RATHORE JAI HIND [IN]; RATHORE BHARATI [IN]; RATHORE PRATIBHA [IN]; RA) 30 May 2014 (2014-05-30) page 6, paragraph 4 - page 10, paragraph 3; figures 1-10</td>
<td>1-48</td>
</tr>
<tr>
<td>A</td>
<td>WO 03/030961 A2 (MAXXON INC [US]) 17 April 2003 (2003-04-17) page 7, lines 7-13; figures 1-6</td>
<td>1-48</td>
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</table>

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

*"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"Z" document member of the same patent family

Date of the actual completion of the international search: 30 June 2016
Date of mailing of the international search report: 05/09/2016

Name and mailing address of the IB:\nEuropean Patent Office, P.B. 5818 Patentbaan 2
NL-2280 HV Rijswijk
Tel: (+31-70) 340-2000
Fax: (+31-70) 340-5016

Authorized officer: Diamantouros, S

Form PCT/ISA/210 (second sheet) (April 2009)
## INTERNATIONAL SEARCH REPORT

**International application No**

PCT/IB2016/051060

<table>
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<th>Publication date</th>
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<tr>
<td>WO 2014080420 A2</td>
<td>30-05-2014</td>
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<td></td>
<td>WO 0303961 A2</td>
<td>17-04-2003</td>
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This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-48
   Fluid injecting system
   ---

2. claims: 49-56
   Fluid collector
   ---
Continuation of Box II.1

Claims Nos.: 57-68

Claims 57-68 are not treated in this opinion, because they disclose a method for the treatment of the human or animal body by therapy (Rule 39.1(iv) PCT). More specifically, claim 57 discloses a "fluid injecting method". Even though this formulation does not specifically mention that a medicament will be injected into a patient, it is broad enough and it does not exclude it, while from the description it is clear that the device is supposed to administer a drug into a patient (see "object of the invention" in the description and also the section "background of the invention"). Similarly, claim 63 discloses a fluid collecting method, wherein a needle is inserted into a "target fluid source", collecting a fluid. It is clear that also this claim refers to the collection of fluids from a patient. In order for these and their dependent claims to be deemed as fulfilling the requirements of Rule 39.1(iv) PCT, the use of the invention for the treatment of patients will have to be excluded. Care should be taken not to introduce subject-matter which extends beyond the content of the application as filed, according to Article 19(2) PCT.
WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43bis.1)

Date of mailing (day/month/year) see form PCT/ISA/210 (second sheet)

Applicant’s or agent’s file reference see form PCT/ISA/220
International application No. PCT/IB2016/051060
International filing date (day/month/year) 26.02.2016
Priority date (day/month/year) 10.03.2015
International Patent Classification (IPC) or both national classification and IPC INV. A61M5/32 ADD. A61M5/24
Applicant RATHORE, JAI HIND

1. This opinion contains indications relating to the following items:

☐ Box No. I  Basis of the opinion
☐ Box No. II  Priority
☐ Box No. III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐ Box No. IV  Lack of unity of invention
☐ Box No. V  Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
☐ Box No. VI  Certain documents cited
☐ Box No. VII  Certain defects in the international application
☐ Box No. VIII  Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1.bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:
European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0
Fax. +49 89 2399 - 4465

Date of completion of this opinion see form PCT/ISA/210

Authorized Officer
Diamantouros, S
Telephone No. +49 89 2399-0

Form PCT/ISA/237 (Cover Sheet) (January 2015)
Box No. 1  Basis of the opinion

1. With regard to the language, this opinion has been established on the basis of:
   - ☑️ the international application in the language in which it was filed.
   - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 45bis.1(a))

3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:
   a. ☐ forming part of the international application as filed:
      - ☐ on paper or in the form of an image file.
   b. ☐ furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C.ST.25 text file.
   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
      - ☐ in the form of an Annex C.ST.25 text file (Rule 13ter.1(a)).
      - ☐ on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 715).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Form PCT/ISA/237 (January 2015)
Box No. III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of

☐ the entire international application

☒ claims Nos. 49-68

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international search (specify):

☐ the description, claims or drawings (indicate particular elements below) or said claims Nos. are so unclear that no meaningful opinion could be formed (specify):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed (specify):

☒ no international search report has been established for the whole application or for said claims Nos. 49-68

☐ a meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

☐ furnish a sequence listing in the form of an Annex CST 25 text file, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

☐ furnish a sequence listing on paper or in the form of an image file complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

☐ pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13ter.1(a) or (b).

☒ See Supplemental Box for further details
Box No. IV  Lack of unity of invention

1. ☑ In response to the invitation (Form PCT/ISA/206) to pay additional fees, the applicant has, within the applicable time limit:
   - ☐ paid additional fees
   - ☐ paid additional fees under protest and, where applicable, the protest fee
   - ☐ paid additional fees under protest but the applicable protest fee was not paid
   - ☑ not paid additional fees

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
   - ☐ complied with
   - ☑ not complied with for the following reasons:
     
     see separate sheet

4. Consequently, this report has been established in respect of the following parts of the international application:
   - ☐ all parts.
   - ☑ the parts relating to claims Nos. 1-48

Box No. V  Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

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2. Citations and explanations

see separate sheet

Form PCT/ISA/237 (January 2015)
WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

Box No. VII  Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII  Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet
Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

Claims 57-68 are not treated in this opinion, because they disclose a method for the treatment of the human or animal body by therapy (Rule 39.1(iv) PCT). More specifically, claim 57 discloses a “fluid injecting method”. Even though this formulation does not specifically mention that a medicament will be injected into a patient, it is broad enough and it does not exclude it, while from the description it is clear that the device is supposed to administer a drug into a patient (see “object of the invention” in the description and also the section “background of the invention”). Similarly, claim 63 discloses a fluid collecting method, wherein a needle is inserted into a “target fluid source”, collecting a fluid. It is clear that also this claim refers to the collection of fluids from a patient.

In order for these and their dependent claims to be deemed as fulfilling the requirements of Rule 39.1(iv) PCT, the use of the invention for the treatment of patients will have to be excluded.

Care should be taken not to introduce subject-matter which extends beyond the content of the application as filed, according to Article 19(2) PCT.

Re Item IV

Lack of unity of invention

This Authority considers that the application does not meet the requirements of unity of invention and that there are 2 inventions covered by the claims indicated as follows:

1. Fluid injecting system (claims 1-48)
   Features:
   a) Injector
   b) Plunger assembly
   c) Fluid container
   d) Needle retraction mechanism

2. Fluid collector (claims 49-56)
   Features:
a) Fluid container  
b) Piston assembly  
c) Container cover  
d) Fluid suction mechanism  

The reasons for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

(a) The common feature of the two inventions is that they are directed towards a plunger carrying system with a fluid container. This is a well-known feature in the art and does not from a single general inventive concept.

(b) The technical effects of the remaining features is:

Invention 1: The vacuum created by the double plunger is used to retract the needle.  
Invention 2: The vacuum created by the double plunger is used for the suction of fluid.

It is obvious that these 2 inventions solve different technical problems and that the technical relationship between the subject-matter of the groups of claims referring to the inventions required by Rule 13.1 PCT is lacking.

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following documents:

D1  
WO 2014/080420 A2 (RATHORE JAI HIND [IN]; RATHORE BHARATI [IN]; RATHORE PRATIBHA [IN]; RA) 30 May 2014 (2014-05-30)

D2  
WO 03/030961 A2 (MAXXON INC [US]) 17 April 2003 (2003-04-17)

Document D1 seems to be the prior art closest to the subject-matter of claim 1. Claim 1 differs from it in that:

(a) A united plunger barrel is formed by the engagement of an outer and an inner barrel.  
(b) The fluid cartridge can be disengaged from the injector so that the injector can be reused.
The technical effect of these features is that the injector is reusable while the only parts to be discarded are the needle hub and the medicament cartridge. As a result a cheaper and friendlier to the environment system is achieved without an increased risk of needle injuries.

Document D1 does not contain any hints towards making a reusable injector with a vacuum driven retractable needle. It indeed stresses the fact that the device should be single-use for safety reasons. Therefore, it appears that claim 1 is novel and inventive according to Articles 33(2) and 33(3) PCT.

The dependent to it claims will also be novel and inventive.

Re Item VII
Certain defects in the international application

1 Independent claims should be in the two-part form (Rule 6.3(b) PCT).

2 The description should be brought in conformity with any amended claims (Rule 5.1(a)(iii) PCT).

3 The basis for any amendments should be identified in the application as filed (Article 19.1 PCT).

Re Item VIII
Certain observations on the international application

The application does not meet the requirements of Article 6 PCT, because claim 1 is not clear.

1 The term "injector having an injector body" is vague and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT.

2 The creation of the vacuum between the outer and inner plunger barrel is defined in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result.

3 In addition, the retraction of the hypodermic needle within the fluid cartridge is also defined in terms of result to be achieved.
It is mentioned that the movement of the outer plunger barrel is restricted in the forward direction, which leads to the creation of the vacuum, but also that the device is reusable. It is not clear how these two features are compatible.

It is clear from the description that the following features are essential to the definition of the invention:

(a) Plunger head 31 and cavity 66. Without these features the barrel plunger cannot connect to the cartridge plunger to form a single plunger unit 67.
(b) Needle catch projection 65 and conical cavity 75. These features make the connection between plunger and needle hub possible.
(c) U clip locking means 35 with conical lock-notch 34 and partition ring 11. This feature locks the two plunger barrels together and keeps them locked until the end of the injection, when the needle retraction starts.
(d) The geometry of inner and outer plunger, the seal holder 25 and the seal 26. These features make the creation of the single barrel and of the vacuum possible.

Since independent claim 1 does not contain these features it does not meet the requirement following from Article 6 PCT taken in combination with Rule 6.3(b) PCT that any independent claim must contain all the technical features essential to the definition of the invention.
A fluid injecting system (100) comprising an injector (A) having an injector body (10), a plunger shaft (30), a plunger assembly (20) having an inner plunger barrel (21) slidably within an outer plunger barrel (22), a fluid-cartridge (B) having a fluid (53) and a hypodermic needle (72) for injecting the fluid(53) at an injectable site. The fluid-cartridge (B) is configured to releasably engage with the injector (A). A vacuum (V) is created between the outer plunger barrel (22) and the inner plunger barrel (21) upon formation of a united plunger barrel (40). Also, forward movement of the united plunger barrel (40) transfers the fluid(53) from the fluid-cartridge (B) into the injectable site. The hypodermic needle (72) retracts within empty fluid-cartridge (B) due to release of the vacuum (V) and the injector (A) is disengaged from the fluid-cartridge (B) for reuse. Further, a fluid injecting method (300) is provided.

The Vacuum Retractable Safety Syringe (VRS) 100 for single use comprises a plunger barrel assembly 114, outermost barrel 102 and a needle carrier assembly 104 holding a detachable needle 140 along with needle cover 142. The plunger barrel assembly comprises an inner and an outer plunger barrels. The outer plunger barrel 112 is provided with two diametrically opposite longitudinal slots 172 & 173 holding conical notches 145 &146 of finger locks 143 & 144, provided at the distal end of the inner plunger barrel. The inner plunger barrel housing inside the outer plunger barrel is also provided with a second piston seal 150 at proximal end. The outer plunger barrel 112 opening at proximal end is provided with a first piston seal 170 at the outer surface. The plunger plug 110 provided with a centrally positioned furrowed knob 154 at proximal surface is fixedly mounted at the proximal end of the outer plunger barrel. The finger lock 166 is provided at the distal end of outer plunger barrel to prevent the removal of plunger assembly from the outermost barrel. The outer most barrel comprises a uniformly elongated hollow cylindrical tubular body, provided with a conical jacket 126 opening at the proximal end, a finger rest 128 and two sets of uniform, inner circumferential C-grooves 120 and 122 at distal end. A conical needle carrier assembly 104 comprising a hollow conical needle carrier 139, holding a detachable straight hollow hypodermic needle, is fixedly mounted in the conical jacket of the outermost barrel with the help of an elastic O-ring 136. The needle carrier is provided with a cavity 130 with locking means 132 to capture the knob 154 provided in the plunger plug 110, which opens in a detachable straight hollow hypodermic needle 140 at proximal end. While working with the syringe, the plunger assembly 114 is pulled in backward direction until the notches 145 & 146 get engage therein the conical groove 122 to fix the inner plunger barrel. Further push of the plunger barrel in forward direction, creates a vacuum between the plunger plug 110 and inner plunger barrel 108. The medicinal dosage may be sucked into the chamber between the outermost barrel and plunger assembly as usual. As soon as the last drop of medicine is injected into the body of patient, the furrowed nipple 154 inserts and snap locks into the cavity 130 of needle carrier assembly 104 with the help of locking members 156 and 132. The plunger assembly 114 pushes the O-ring 134 in forward direction, to dislodge the needle carrier, consequently, the plunger plug 110 holding needle carrier along with needle gently retracts in backward direction and finally encapsulates inside the plunger barrel due to the pull of vacuum. Simultaneously, the outwardly protruded finger lock 166 snap locks within the conical groove 120 to completely lock the plunger barrel 112 inside the outermost barrel 102 to render the complete syringe assembly quite unusable for any further use.

The Auto-Retractable Safety Syringe 100 for single use comprises a plunger assembly 142 to slidably and axially move inside the outermost barrel 124, holding a needle carrier assembly 122 in conical jacket 174 at proximal end. The plunger assembly 112 comprises a needle retraction assembly, which further comprises a retraction shaft 106, housing inside the retraction hub 104 along with a compressed spring 160. The shaft is provided with a piston seal 142 at distal end and an axially furrowed nipple 158 at proximal end. The shaft is also provided with...
an outer circumferential conical groove 156 at proximal end, which facilitates the shaft to be held firmly along with a compressed spring 160 inside the retraction hub 104 with engagement of conical notch T-1 of outwardly protruded finger lock 146 provided in the retraction hub 104. The proximal portion of the finger lock 146 is customised into a flange 148 to remains in contact of distal surface of ring plate 162. At proximal end the retraction assembly is provided with a combination of two parallel ring plates 162 and 164, wherein the distal plate is diametrically provided with oppositely positioned two axial pins P-I and P-2 which slidably protrude out at proximal ends, passing through the respective holes H-1 and H-2 provided in proximal ring plate 164. The needle carrier assembly comprises a hypodermic needle having an axial cavity 186 at distal end, housed in axial passage of needle carrier hub 118 and engages therein with the inner conical teeth T-3 of finger lock 194 through outer circumferential groove 178. The needle carrier assembly is housed inside the conical jacket 174, provided at proximal end of outermost barrel 114 through a combination of an O-ring 200 and a ring plate 202. During the completion of injection process the nipple 158 inserts in distal cavity 186 to engage needle 166 and the finger locks 194 of needle carrier assembly as well as 146 of needle retraction assembly open simultaneously due to the pressure exerted on their respective flanges 190 and 148 by movement of plunger assembly in forward direction. This action facilitates to retract the shaft 106 along with needle 116 to dislodge and gently move in backward direction and finally encapsulate needle 116 in plunger barrel 102. The outwardly protruded finger lock 134 provided at distal end of the plunger barrel 102 also clicks lock the plunger barrel inside the outermost barrel by seating conveniently in the inner circumferential conical groove 168 provided at the distal end of the outermost barrel 114 to completely lock the syringe and render it useless for any further use.

4. WO/2014/080417 SELF-RETRACTABLE SAFETY SYRINGE FOR SINGLE USE

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The present subject matter relates to self-retractable safety syringe (100) for single use comprising a plunger assembly including a plunger barrel (102) and a plunger plug (103), a needle carrier assembly (114), and an outermost barrel (108). The plunger plug (103) holding a centrally positioned furrowed axial knob (134) housed in plunger barrel (102) at the proximal end and firmly held by the inner teeth T-2 & T-4 of finger locks (126) and (128) respectively. A needle carrier assembly (114) is housed in conical jacket of outermost barrel 108 holding a needle (110) along with a compressed spring (184). The needle is locked inside the needle carrier assembly with the help of finger lock (166) provided with outwardly protruded flange (168). The flange (168) is placed in contact with a slidable elastic O-ring (182) holding the needle carrier assembly inside the conical jacket. At the completion of injection process, the furrowed knob inserts into the distal cavity of needle (110) to lock the needle with plug. When the elastic O-ring slides in forward direction due to the axial movement of plunger barrel in forward direction, the O-ring pushes the flange (168) of finger lock (166), to unlock the lock. At the same time, the teeth outer T-1 & T-3 of the finger locks (126) & (128) respectively become in alignment of inner circumferential conical groove (148) of outermost barrel (108) and restore their normal state by expanding in outward direction to occupy the outer space provided by the groove (148). This result the respective inner teeth T-2 & T-4 of the finger locks (126) & (128) to retract and release the plunger plug (103) due to expansion of locks in outward direction. Consequently, the plunger plug (103) holding the needle (110) moves smoothly in backward direction due to the pressure exerted by expansion of (spring 184) in backward direction. Simultaneously, the finger lock (124) provided at the distal end of plunger barrel (102) slips into the inner circumferential conical groove (146) and click locks the plunger barrel (102) inside the outermost barrel (108) to render the syringe assembly completely locked with the needle encapsulated within the plunger barrel. The distally directing, outwardly protruded finger locks (125) and (127) provided at the proximal end of plunger barrel prevent the removal of plunger barrel (102) from the outermost barrel (108).

5. WO/2014/072993 FOLDED- PLUNGER AUTO-RETRACTABLE DISPOSABLE SYRINGE

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The present subject matter relates to a folded- plunger auto- retractable disposable syringe (100) which includes a needle carrier assembly (109) and a folded plunger assembly (111) for respectively inserting in an outermost barrel (106). The folded plunger assembly (111) is provided with at least one oppositely positioned circumferential C-groove (118) on the outer surface at its proximal end P constituting a ridge (130). The folded plunger assembly also includes at least one outwardly protruded finger lock (116) to get engaged with an outer plunger barrel (104), and a piston seal holder (112) structured at the proximal end P for holding a piston seal (114). The outer plunger barrel (104) includes at least two pair of oppositely positioned finger locks (128, 130 & 132, 134) wherein each pair of lock is diametrically aligned opposite to each other and positioned at the distal end of the barrel where two diameters of barrel bisect each other perpendicularly. The outer plunger barrel (104) is also provided with a second piston seal holder (120) at proximal end P for holdings second piston seal (122). The present subject matter also discusses about the needle carrier assembly (109) for housing in the outermost barrel 106 before inserting the folded plunger assembly (111). The needle carrier assembly (109) includes a
The present subject matter relates to an auto retractable safety syringe (100) for single use which includes a needle carrier assembly (108) and a folded plunger assembly (200) respectively for inserting in an outermost barrel (110). The folded plunger assembly (200) is provided with an inner plunger barrel (102), an outer plunger barrel (104) and a plunger plug (106). The inner plunger barrel (102) is provided with at least one oppositely positioned circumferential C-groove (122) on outer surface at its proximal end P, a pair of oppositely positioned finger locks (118 and 120) on either end to get engaged with an outer plunger barrel (104), and a piston seal holder (114) structured at the proximal end P for holding a piston seal (116). The outer plunger barrel (104) includes at least one pair of oppositely positioned finger locks (156 and 158) on both ends and a second piston seal holder (124) at proximal end P for holding another piston seal (126). The folded plunger assembly is also provided with the plunger plug (106) which is designed with at least one uniform circumferential groove (136) wherein the plunger plug (106) is centrally designed with a longitudinally furrowed knob (140) at its proximal end P. The present subject matter also discusses about the needle carrier assembly (108) for housing in the outermost barrel (110) in which the needle carrier assembly (108) includes a seat and internal locking arrangement (148) provided in a central axial passage opening designed in a cavity (146) at the distal end D to snap lock the furrowed knob (140) present in the plunger plug (106), a needle (152) provided with a needle cover (154) at the proximal end P of the needle carrier assembly (108), and the elastic O-rings (132) to support and hold the needle carrier assembly 108 inside the outermost barrel (110), and to dislodge the assembly on completion of injection. The present invention further explains that the outermost barrel (110) designed to receive the folded plunger assembly (200) after getting in the needle carrier assembly (108), wherein the outermost barrel (110) is provided with a finger rest (128), a uniform obtuse-angled L-shaped inner circumferential conical groove (130) and a conical jacket opening (134) at the proximal end of the outermost barrel (110).