

[54] **NEEDLE ASSEMBLY WITH
LONGITUDINALLY MOVABLE FILTER**

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128/215, 216, 214 C, 2 F, 272, 276, 218 R,
220, 218 NV, 218 M, 218 D

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[57] **ABSTRACT**

A needle assembly for use with a medical injector such as a syringe or drip set. The needle assembly is provided with a filter element in a fluid passage formed therein for completely removing dust particles which might exist in a dosage solution or in a blood transfusion when injected or dripped into a human body.

1 Claim, 8 Drawing Figures

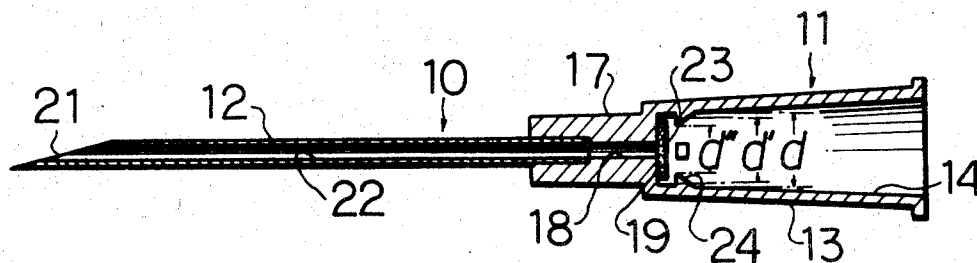


Fig. 1

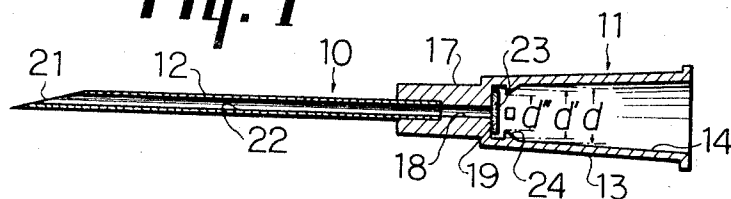


Fig. 2

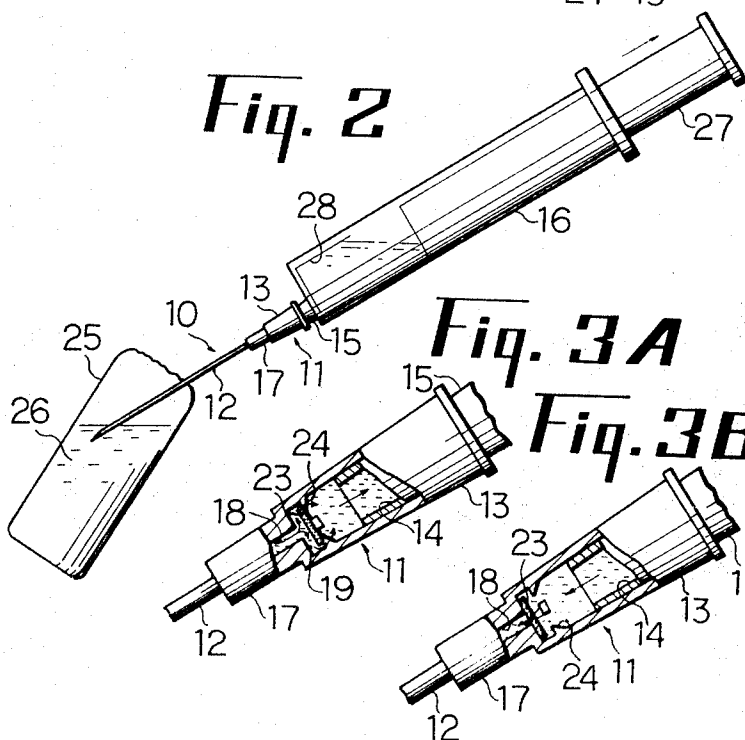


Fig. 3A

Fig. 3B

Fig. 4

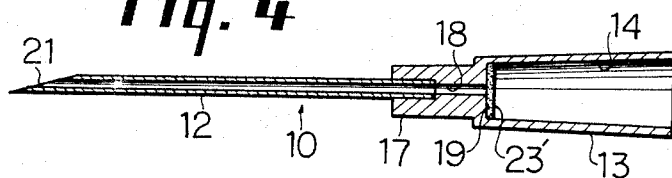


Fig. 5

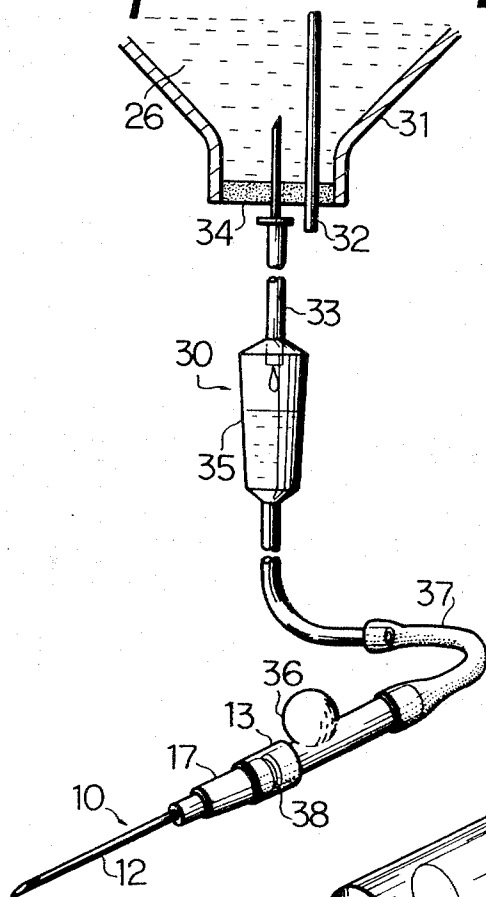


Fig. 6

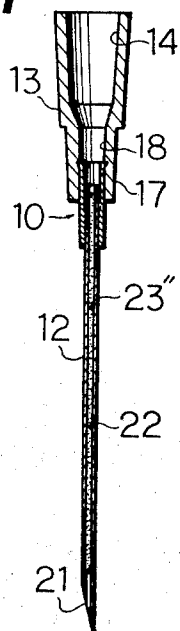
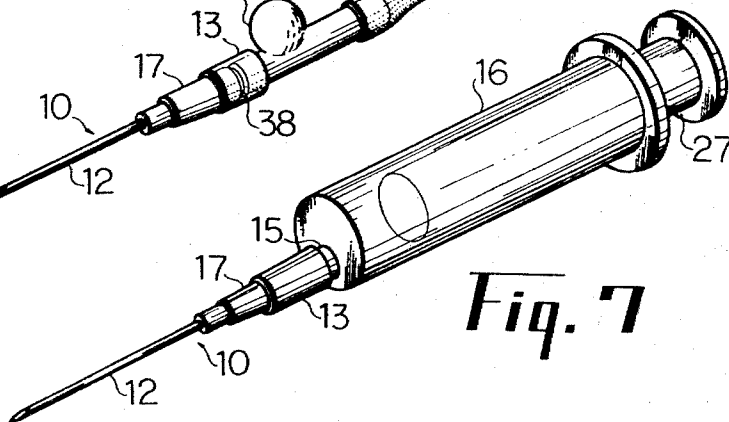


Fig. 7



NEEDLE ASSEMBLY WITH LONGITUDINALLY MOVABLE FILTER

The present invention generally relates to a needle assembly for use with a medical injector such as a syringe or drip set and, more specifically, to a needle assembly of the above type for completely removing dust particles which might exist in a dosage solution or in a blood transfusion when injected or dripped into the human body.

Dosage solutions such as a usual injection blood-for-blood transfusion or glucose solution are packed in an ampoule or in a so-called Bayer bottle in a sterile condition for shipping. The packing process is usually under a careful administration so as to prevent an ingress of dust particles into the dosage solutions. However, the admixture or existence of the dust particles in the dosage solutions can not be completely avoided. For example, when the head portion of an ampoule is cut away to extract a dosage solution therefrom into a syringe for injection, fine fragments of glass may drop in the ampoule and therefore may be aspirated into a barrel of the syringe. When, moreover, a needle adaptor of a drip set is inserted into a rubber tap sealing the Bayer bottle for effecting dripping of a dosage solution, fine chips of rubber may also enter the particular bottle. On the other hand, dust particles floating in the air may chance to steal into such containers during the above operations. It is extremely harmful and dangerous to introduce the dosage solution, containing these dust particles, into a human body.

Notwithstanding this fact, it has never been proposed to provide any removing or filtering means in the conventional syringe or in its needle, thus suffering the above serious danger. On the other hand, a pouched filter made of synthetic fibers is provided in a fluid passage, for example, in the drip chamber or plastic tubing of the drip set. However, the filter has rough structure so that satisfactory filtering effect can not be expected. Even if, in this instance, the conventional pouched filter had such dense structure as to afford sufficient filtering effect, some danger would still exist due to the fact that it is located midway of the fluid passage, with its downstream left unfiltered.

It is, therefore, an object of the present invention to provide an improved needle assembly for use with a medical injector for eliminating the above disadvantage.

Another object of the invention is to provide an improved needle assembly having a filter element for completely removing the dust particles which might exist in a dosage solution when it is introduced into a human body.

According to one of the important features of the invention, the filter element is of dense structure so that highly effective filtering operation can be achieved.

According to another important feature of the invention, the filter element is provided directly in a needle, namely, at the closest position to a human body, thus minimizing the prospective steal of the dust particles into the dosage solution.

Other features and advantages will be understood from the description made with reference to the accompanying drawings, in which:

FIG. 1 is a longitudinal section of a needle assembly according to the invention, in which a disc-shaped filter is longitudinally movably provided in a needle holder;

FIG. 2 is a plan view of the needle assembly of FIG. 1 when it is fitted for use to a syringe;

FIGS. 3A and 3B are partially cutaway explanatory views of the needle assembly of FIG. 1, respectively showing the locations of the filter when in aspiration and injection operations;

FIG. 4 is similar to FIG. 1 but shows another embodiment of the invention, in which a disc-shaped filter is fitted in the needle holder;

FIG. 5 is a plan view of the needle assembly of FIG. 4 when it is fitted for use to a drip set;

FIG. 6 is also similar to FIG. 1 but shows a further embodiment of the invention, in which a stick-shaped filter is tightly fitted in the needle bore; and

FIG. 7 is a plan view of the needle assembly of FIG. 6 when it is fitted for use to a syringe.

Referring now to FIGS. 1 and 2, a needle assembly of the present invention is generally designated at numeral 10, which is composed of a needle holder 11 and a pointed needle 12. A counter-tapered portion 13 of the needle holder 11 is of generally cylindrical shape and has a counter-tapered longitudinal bore 14 formed therein. This bore 14 is shaped and sized to be securely fitted over an externally tapered end 15 of a syringe barrel 16, as best shown in FIG. 2. The fitting or locking of the needle assembly 10 and the tapered end 15 may be carried out with use of the so-called Luer lock. The other reduced portion 17, which is integral with the counter-tapered portion 13, has also a longitudinal bore 18 of reduced diameter in alignment with the countertapered bore 14. Thus, the merging inner end of the two portions 13 and 17 has a stepped form, as indicated at 19 in FIG. 1. The needle 12 is inserted into the reduced bore 18 and is embedded or anchored in the wall of the reduced portion 17, as shown. The needle 12 is pointed as customary by obliquely machining the open end 21 thereof. A longitudinal bore 22 is also formed in the needle 12, thus providing a fluid passage leading from the counter-tapered bore 14 to the needle bore 22 through the reduced bore 18.

According to the invention, a disc-shaped filter 23 is provided in the particular fluid passage in a manner to be longitudinally movable therein within a limited distance. More particularly, a plurality of inwardly extending projections 24 are formed on an annular inside periphery of the counter-tapered portion 13 at a spacing from the stepped inner end 19 of the reduced portion 17. This spacing is determined in accordance with the distance within which the filter 23 is permitted to longitudinally move. For this longitudinal movement, the diameter d' of the filter 23 is present slightly smaller than the smallest diameter d of the counter-tapered bore 14 but is larger than the diameters, not named, of the reduced bore 18. In order to confine the filter 23 within the above spacing, the diameter d' of the filter 23 should be larger than the inner diameter d'' of the projections 24.

Operations of the needle assembly 10 will now be explained with reference to FIGS. 2, 3A and 3B. When the needle 12 is dipped into an ampoule 25 containing a suitable dosage solution 26, and when a piston 27 telescopically received by the syringe barrel 16 is pulled in the direction of an arrow P, as shown in FIG. 2, then suction is established in the fluid passage to thereby aspirate the dosage solution 26 into the counter-tapered bore 14 through the needle bore 22 and the reduced bore 18 in this sequence. At this particular instant, the

disc-shaped filter 23 is conveyed by the suction flow of the dosage solution with the resultant abutment against the inner surfaces of the projections 24, as shown in FIG. 3A. The flow of the dosage solution is then allowed to freely pass around the filter 23 into the chamber 28 formed in the syringe barrel 16.

When injection is to be administered, on the other hand, the filter 23 is pressed tightly onto the stepped inner end 19 of the reduced portion 17 by the reverse flow of the dosage solution. In this instance, this reverse flow is allowed to pass only through the central portion of the filter 23, as shown in FIG. 3B. Thus, the dust particles, which might have been sucked into the chamber 28 during the aspiration operation, can be completely removed from the dosage solution after it has passed through the filter 23 for injection into the human body, not shown. Consequently, the needle assembly 10 hereinbefore described finds its best application to a needle for an injection syringe.

The material which can be used for this filter 23 is not restricted, if it is of medically harmless property and of highly dense structure. For instance, the filter may preferably be made of synthetic resins, such as nylon (R.T.M.) or highly dense polyethylene, having a particle size of 10 - 20 microns. More specifically, the filter is prepared by pressure-moulding the above material into a disc shape of a desired diameter *d*. The moulded filter may preferably be baked to sinter the material. If the sintered filter has a resilient property, it can be filled between the inner end of the reduced portion and the projections by slightly warping or bending. If, on the contrary, the filter is required to have a sufficient rigidity, the once moulded filter may be baked after it has been inserted therebetween. The filter obtained by the latter method is advantageous in that it has such a dense structure as to remove more efficiently the prospective dust particles.

Turning now to FIG. 4, a modified disc-shaped filter 23' is securely mounted on the stepped inner wall 19 in this embodiment. It should be noted here that like reference numerals appearing hereinafter will indicate counterparts numbered in FIGS. 1 to 3B. The filter 23' has a diameter slightly larger than the smallest inside diameter, not shown, of the counter-tapered bore 14. In this instance, after the filter 23' has been moulded (and baked, if desired), it is tightly fitted in the bore 14 to be seated on the stepped end 19 in frictional engagement with the surrounding annular inside wall of the countertapered portion 13.

This type of filter 23' might slip out of the annular inside wall, if it were used for the aspiration operation. Therefore, this filter can be used only in combination with a drip set. However, if the filter is adhered to the stepped wall 19 by the use of a suitable adhesive, then the above slippage is eliminated so that it can also be used in combination with an injection syringe.

The conventional drip set as generally designated at numeral 30 is provided with the so-called Bayer bottle 31 having an air vent conduit 32. The drip set 30 is further provided with a needle adaptor 33, which is shown in condition for use in FIG. 5 as being inserted into the inside of the Bayer bottle 31 through a rubber tap 34. The dosage solution or blood 26 is delivered by the water head into a drip chamber 35 and further to another adaptor 36 through a suitable tubing 37. The thus delivered dosage solution is then introduced into the human body, not shown, through the needle assembly

10, which is hermetically fitted over the end 38 of the adaptor 36. In this manner, the dosage solution flows downward, in other words, only in the one-way direction, so that the filter 23' need not be provided longitudinally movably in the particular fluid passage. This remarkably simplifies the preparation of the filter and accordingly leads to considerable reduction in its production cost.

Reference is now to be made to FIGS. 6 and 7, in which a stick-shaped filter 23'' is tightly fitted in the needle bore 22. For improving the filtering efficiency, this filter 23'' may preferably occupy the total length of the needle bore 22.

This type of needle assembly 10 may be prepared by inserting into the bore 22 the stick-shaped filter which has been moulded (and baked, if desired). However, it is preferable that the preparation is performed by the process including the steps of filling a powdered material of synthetic resin into the needle bore and baking the needle assembly as a whole to form a sintered stick-shaped filter.

The needle assembly 10 of this embodiment can be used with the drip set 30 in a similar manner to the previous embodiment shown in FIG. 4. However, this needle assembly 10 can also be used in combination with an injection syringe, as shown in FIG. 7. In a proposed safe use, the aspiration operation is performed with use of a first needle assembly which has been connected to the tapered end of the injection syringe. After removal of this first needle assembly, a second needle assembly in connected to the syringe in place of the first one. As a result, the injection operation can be accomplished with use of the second non-contaminated assembly. Although this use may cost more per an injection operation and may require the tedious replace operation, it should be appreciated that a serious danger concomitant with inclusion of the dust particles can be completely avoided. As has been pointed out previously, this use can also be effected by the needle assembly of FIG. 4, when the filter 23' is adhered to the stepped end 19.

From the above description, the needle assembly according to the present invention is of simple structure but can effectively remove the prospective dust particles, thus insuring safety for injection. Therefore, the needle assembly finds a wide variety of applications such as intravenous, intramuscular and hypodermic injections.

What is claimed is:

1. A needle assembly for use in a medical injector, comprising a substantially cylindrical needle holder having a tapered bore for communication through its enlarged end with a chamber in said injector and a passageway leading from a reduced end of said bore and smaller in cross sectional diameter than the bore, a needle connected to said needle holder and having a passageway aligned and communicating at one end with said passageway in the needle holder, said needle having an opening at the other end forming a piercing point, a plurality of annularly spaced projections formed on an inner peripheral surface of said needle holder defining said bore and located in proximity to said reduced end of said bore, and a substantially disc-shaped filter element movable between said reduced end and said projections and having a thickness smaller than a distance between said reduced end of said bore and said projections, said filter having a diameter substantially smaller than a diameter of said reduced end of said bore and larger than a diameter of said passageway in said needle holder and a diameter of a circle described by ends of said projections.

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