Nov. 28, 1950 B. J. BRENT 2,531,667

METHOD OF AND APPARATUS FOR ADMINISTERING REPEATED INJECTIONS

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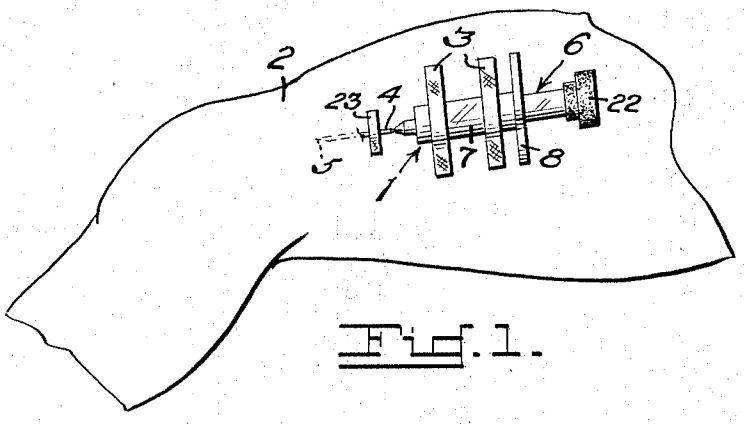


Fig. 1.

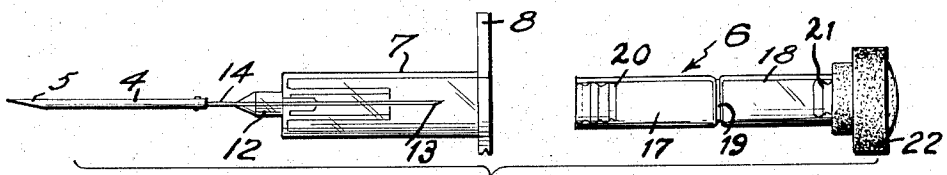


Fig. 2.

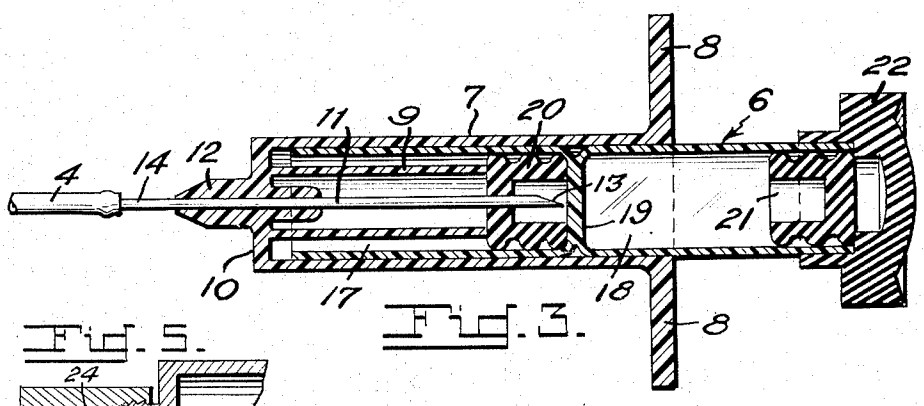


Fig. 3.

Fig. 5.

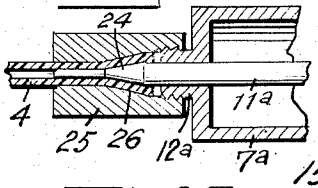


Fig. 6.

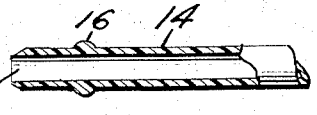
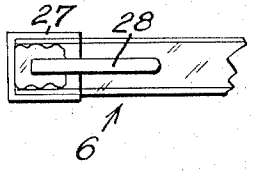


Fig. 4.



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METHOD OF AND APPARATUS FOR ADMINISTERING REPEATED INJECTIONS

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Application December 1, 1947, Serial No. 789,088

10 Claims. (Cl. 128—220)

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This invention relates to method of and apparatus for administering repeated injections; and it comprises a syringe, adapted to be strapped to the leg or arm of a patient, for example, provided with a flexible discharge tube adapted to dwell in a patient during the period of treatment; said syringe comprising in combination a barrel having an open end and a closed end, an upstanding plunger mounted centrally in said barrel and extending from said closed end to a point about half-way to the open end of said barrel, an injection needle mounted longitudinally in and extending through said plunger and passing through the closed end of said barrel, said needle having a sharpened inlet end extending a short distance beyond said plunger and a discharge end, a flexible injection tube having an inlet end secured to the discharge end of said needle and a discharge end adapted to be inserted in a patient, a tubular ampoule containing an injection fluid having a sliding fit inside said barrel and adapted to receive and to slide over said plunger during an injection, said ampoule having a discharge end and a closed end, a resilient plug normally closing said discharge end, and means for thrusting said ampoule into said barrel; said plunger, ampoule, needle and barrel being so constructed and arranged that when said ampoule is inserted in said barrel and thrust home the inlet end of said needle punctures said plug thereby establishing communication between the interior of said needle and the interior of said ampoule and said plunger presses said plug through the body of the ampoule causing the liquid in the ampoule to be discharged through said needle and through said flexible tube into the patient. The invention also includes a method of administering repeated injections by means of said syringe which comprises inserting the discharge end of the flexible tube of the syringe into a patient, securing the barrel of the syringe to a patient in such manner that the tube end will not be accidentally withdrawn, inserting the sterilized plugged end of said ampoule in said barrel, pressing the ampoule home thereby discharging the injection fluid through said flexible tube into the patient, keeping said ampoule in its thrust home position until time for a second injection, then withdrawing said ampoule, inserting the sterilized plugged end of a second ampoule into said barrel and thrusting it home thereby injecting its fluid into said patient and continuing the described procedure during the period of treatment; all as more fully hereinafter set forth and as claimed.

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Modern therapeutics frequently requires a plurality of intravenous or other injections to be made at frequent intervals and over periods which may extend for several days or weeks. Owing to the acute shortage of skilled medical attendants, cases of this type have presented a difficult problem to the medical profession. Several different injection techniques have been developed for this purpose making use of an injection needle inserted in a vein and left in situ over the period during which repeated injections are required. In one method a rubber membrane has been attached at the end of the needle and injections have then been made through this membrane. In others rubber tubes or needles have been left inserted in a vein and various devices have been developed to enable syringes to be attached, discharged into the vein and then removed without contamination. None of these devices has proved to be entirely successful, some causing injury to the vein and some being subject to contamination while all have required at least semi-skilled attendants to operate them.

I have discovered what appears to represent an ideal solution to the problem outlined above in that I have discovered a method which eliminates the necessity for skilled attendants to administer the injections and have therefore made it possible for the patient to become ambulatory and even to engage in normal routine work during the period of treatment. My new injection device makes use of a syringe which is usually attached to the leg of the patient and provided with a flexible tube inserted and left to dwell in the patient during the period of treatment. The syringe makes use of replaceable injection ampoules closed with resilient plugs which serve as pistons during the injection operation and in which the syringe needle is adapted to pierce the plugs to establish communication between the interior of the ampoules and the interior of the needle, the discharge end of the needle being attached to a flexible tube which is inserted in the patient. With this type of syringe the only points which must be sterilized during a series of injections are the resilient plugs at the ends of the ampoules since these are the only points contacted by the injection fluid, this contact being made as the needle pierces the plug during the injection. In one embodiment of my invention the plastic plugs are sterilized when the ampoules are made and covered by a removable, sterile cap. With this device it is only necessary to remove the caps from the ends of the ampoules before making injections, no separate sterilization

of the plug being required. But even in the absence of the sterile cap it is a simple matter for the patient to flame the plastic plugs at the ends of the ampoules or to wipe them with a disinfecting solution before inserting the ampoules into the syringe barrel. It is an equally simple matter to press an ampoule into the barrel thus making an injection. The ampoule is left in thrust home position between injections and thus prevents contamination during these periods. The method is more or less fool-proof in that the danger of admitting air into the injection fluid is practically eliminated.

My injection method is applicable in the case of any treatment requiring the repeated injection of therapeutic fluids. It is particularly adapted to intravenous injections but can be applied to intraperitoneal, subcutaneous and other injections as well. Heparin, insulin, cortical extract, desoxicorticosterone and penicillin, for example, can be advantageously administered by this method.

A specific example of an injection fluid which can be administered advantageously by my method is an isotonic solution of sodium heparin containing 50 mg. of sodium heparin per cc. It is possible to inject this heparin fluid intravenously by my method at the rate of 1 to 1.5 cc. at 4 hour intervals with an injection of 2 to 2.5 cc. before retiring, for example, in cases where such treatment is indicated.

My invention can be explained with more particularity by reference to the accompanying drawing which shows more or less diagrammatically several embodiments of my injection syringe and a method of mounting the same on the leg of a patient. In this showing

Fig. 1 is an elevational view of the leg of a patient with one of my injection syringes mounted thereon,

Fig. 2 is an elevation, drawn approximately to scale, of my injection syringe with its ampoule plunger ready to be inserted, while

Fig. 3 is a longitudinal sectional view on an enlarged scale of the syringe with plunger fully inserted, as at the end of an injection,

Fig. 4 is a longitudinal section through the discharge tip of the injection needle, on an enlarged scale, showing means for adapting the needle to receive and hold a flexible injection tube,

Fig. 5 is a partial longitudinal sectional view through the lower end of a modified form of syringe, while

Fig. 6 is a side elevation of one end of a modified ampoule to be used in my syringe.

In the various views like parts are designated by like reference numerals. Referring first to Fig. 1, the syringe, shown generally at 1, is strapped to the patient's leg 2, by bands 3 of adhesive tape or the like. The flexible injection tube or cannula 4, usually made of synthetic rubber, nylon or other flexible material, has its discharge end 5 inserted in a vein and it remains in this position during the treatment. In Fig. 1 the ampoule tube, shown generally at 6, is in its thrust-home position, as at the end of an injection, and it remains in this position in order to prevent contamination until time for another injection.

The details of the syringe are shown best in Figs. 2 and 3. The barrel or cylinder 7 of the syringe is preferably made of an artificial plastic, such as a transparent vinyl polymer resin. At its open outer end it is provided with the conventional finger grip 8. At its closed inner end an upstanding integral plunger 9 is provided which is sealed to the base 10 of the cylinder. A central needle 11 is provided which passes through the base and is supported by a bead 12 of plastic. The outer end 13 of the needle extends beyond the outer end of the plunger 9 for a purpose which will become clear from the following description.

The discharge end 14 of the needle extends outwardly beyond the plastic bead for a sufficient distance to enable the injection tube 4 to be secured thereto. This end is adapted to receive and hold the flexible injection tube, as shown best in Fig. 4. The discharge tip of the needle is advantageously beveled, as at 15, in order to prevent the injection tube from being cut when slipped over this tip and it is usually desirable to provide means close to the tip serving to hold the tube so that it will not become accidentally removed, such as the bead 16. If the end of the needle is knurled for a short distance this also tends to prevent accidental removal of the tube.

In Fig. 5 a modified syringe is shown which is provided with a special means for holding the flexible injection tube on the needle of the syringe. This syringe is constructed of metal and at its lower end it is provided with a short threaded extension 12*a* which is bored to receive the needle 11*a*. The needle can be soldered or otherwise secured in the bore of the extension. The needle is tapered as at 24 to receive the flexible injection tube 4 and a retaining nut 25 is provided with a corresponding internal taper at 26. The nut is internally threaded so it can be screwed on the extension 12*a*. After the flexible tube is slipped over the end of the needle and at least part way over the tapered section of the needle, the retaining nut can then be applied to the extension and, when tightened, its internal taper presses against the end of the flexible tube so as to hold it tightly in position and to prevent accidental removal.

The particular ampoule tube 6 which is shown in Figs. 2 and 3 is divided into two injection fluid holding ampoules 17 and 18 by means of a central partition 19, these ampoules being closed at their outer ends by resilient plugs 20 and 21, usually made of rubber. The ampoule tube is usually constructed of glass although a plastic can be used if desired. At its top a removable resilient cap 22, usually made of rubber, is provided to provide a thumb rest during an injection. The cap has a socket which fits over the end of the tube as shown. The ampoule tube is reversible and, after one ampoule has been used, the cap can be placed over the end of the empty ampoule and the second ampoule is then ready to be used.

In Fig. 6 one end of a modified ampoule is shown. This ampoule is closed at its end by a resilient plug as before but a cap 27, usually made of thin transparent material, fits over its end as shown. The cap is advantageously provided with a tear strip 28 which, when pulled, serves to remove the cap. If a tear strip is used the cap can be made of cellulose hydrate or acetate or any other suitable plastic material and can be applied by shrinking the cap over the end of the ampoule after sterilization or by dipping the sterilized end of the ampoule in a sterile solution of the plastic material. Removal of the cap exposes the rubber plug which requires no further sterilization before being inserted in the syringe.

It is possible to employ a closely fitting rubber

cap in the form of a socket fitting over the end of the ampoule, which can be removed by merely pulling it off. The use of a tear strip is preferable, however, since it is impossible to remove this type of cap without destroying it. This prevents tampering.

In order to inject the fluid from one of the ampoules, the tube 6, after sterilization of its plugged end, if necessary, is inserted into the barrel 7 so that the end 13 of the needle 11 presses against the resilient plug 20. The tube is then thrust home in usual manner during which operation the needle punctures the resilient plug in the ampoule, after which the plunger 9, which fits inside the ampoule, serves to push the plug to the rear of the ampoule. The plug thus acts as a piston to force the injection fluid out of the ampoule through the needle and thus out through the flexible tube 4. The injection fluid which is injected comes in contact only with the tip and the inside of the needle and the inside of the flexible tube during the injection.

The ampoule tube is left in thrust-home position until time for the second injection. At this time it is withdrawn, the cap 22 is removed and placed over the end of the empty ampoule, the tube is then reversed, the end of the plug 21 is sterilized, if necessary, and then the tube is ready to be inserted in the cylinder for the second injection.

When my device is first applied to a patient, the flexible tube is inserted in a vein, for example, by means of a trocar having a lumen slightly larger than the flexible tube. The trocar is first inserted in the vein and the flexible tube is slid through the trocar into its desired position in the vein and the trocar is then removed by sliding it backwardly over the flexible tube while holding the outer end of the tube to prevent its removal from the vein. The flexible tube can then be shortened, if desired, by cutting it with scissors. It is desirable at this point to secure the flexible tube to the body of the patient by placing an adhesive tape over the tube close to the wound in order to prevent accidental removal. The free end of the flexible tube is then attached to the discharge end of the syringe, for example by slipping its end over the syringe needle. The syringe should then be secured to the body of the patient by adhesive tape. Before making the first injection the flexible tube and syringe needle should be free from air. Owing to the capillary effect of the flexible tube and the syringe needle as well as the venus pressure the tube and needle will usually fill with blood without assistance. If necessary, however, a slight suction can be applied to the open end of the syringe barrel to accomplish this result. When this has been accomplished the device is ready for the first injection as described previously.

It should be noted that there is little or no danger of introducing air into the needle between or during injections when use is made of the device described. When the ampoule tube is withdrawn from the syringe cylinder only a slight suction is produced as the needle passes through the resilient plug and, of course, as the end of the needle leaves the plug the needle is full of fluid and remains so during the interval between withdrawal of the ampoule tube and re-insertion. Due to the veinous pressure the needle remains filled or it may even bleed slightly at its end 13 which can be stopped by pressure exerted upon the flexible tube. The ampoules are advantageously air free. Otherwise they are filled to a sufficient extent so that no air can enter the injection needle during an injection. The danger of air embolism is thus completely avoided.

While I have described what I consider to be the most advantageous embodiment of my process it is evident, of course, that various modifications can be made in the specific procedures and structures which have been described without departing from the purview of this invention. As indicated previously my method is indicated whenever repeated injections particularly intravenous injections are required. And it can be used to administer any of the conventional injection fluids. The structure of my syringe can also be varied considerably from that which has been specifically described. Thus, it is obviously possible to employ single- rather than double-ended ampoules holding injection fluid. The relative dimensions of the various parts of the syringe can be varied considerably and the syringe can be constructed of any suitable material, such as glass, metal or plastic. The upstanding plunger which surrounds the needle in my syringe can be made either solid or tubular. The barrel of the syringe can be made of non-circular cross-section if desired. If made of opaque material it can be cut away on one or both sides to provide observation windows. In some cases where a long period of medication is indicated, it is desirable to provide a cover for my device to protect it from being hit or pushed out of place inadvertently. It is also possible to use flexible tubes made of nylon, synthetic rubber or any of the modern plastic elastomers provided that they are completely inert. Various ways of attaching my flexible injection tube to the discharge end of the syringe will occur to those skilled in the art. And any of these can be employed without departing from the present invention. Further modifications of my process and apparatus which fall within the scope of the following claims will be immediately evident to those skilled in the art.

What I claim is:

1. A device for administering repeated injections of therapeutic fluids which comprises in combination an injection syringe having a barrel which is open at one end and provided with a discharge opening at the other end, said barrel being adapted to be secured to the body of the patient during the period of treatment, a replaceable ampoule containing an injection fluid adapted to slide into the open end of said barrel, said ampoule having a discharge end normally closed by a resilient plug, a hollow needle mounted longitudinally in said barrel, with an end adapted to pierce said resilient plug to establish communication between the injection fluid in the ampoule and the interior of said needle when said ampoule is pressed into said barrel, plunger means mounted in said barrel adapted to push said plug as a piston into said ampoule to discharge said fluid into said needle as the ampoule is pressed into said barrel, and a flexible tube having an inlet end communicating with the discharge opening of said syringe and a discharge end adapted to dwell in the patient during the period of treatment.

2. A device for administering repeated intravenous injections which comprises in combination an injection syringe adapted to be secured to the patient during the period of treatment and a flexible injection tube communicating with said syringe, the discharge end of said tube being adapted to dwell in the vein of a patient during the period of treatment; said syringe comprising

a barrel having an open end and a closed end, an upstanding plunger mounted longitudinally in said barrel and extending from said closed end to a point about half-way to the open end of said barrel, an injection needle mounted longitudinally in and extending through said plunger and passing through the closed end of said barrel, said needle having a sharpened inlet end extending a short distance beyond said plunger and a discharge end, the inlet end of said flexible tube being removably secured to the discharge end of said needle, a tubular ampoule containing an injection fluid having a sliding fit inside said barrel and sliding over said plunger during an injection, said ampoule having a discharge end normally closed with a resilient plug serving as a piston to expel the injection fluid through said needle during an injection; said plunger, ampoule, needle and syringe barrel being so constructed and arranged that when said ampoule is inserted in said barrel and thrust home the sharpened inlet end of said needle punctures said resilient plug thereby establishing communication between the interior of said needle and the interior of said ampoule and said plunger presses said plug through the body of the ampoule causing the liquid in the ampoule to be discharged through said needle and through said flexible tube into the vein of a patient.

3. The device of claim 2 wherein a tubular double ampoule is employed with a partition in the center and having a resilient plug at each end holding two bodies of injection fluid.

4. The device of claim 3 wherein a cap is provided to fit over the end of said ampoule and to serve as a thumb rest during the injection.

5. The device of claim 2 wherein means are provided for preventing said flexible tube from being accidentally removed from the end of said injection needle.

6. The device of claim 2 wherein the discharge end of said needle is beveled and provided with a bead to prevent the flexible tube from being accidentally removed.

7. In the administration of repeated injections of therapeutic fluids making use of a syringe having an open-ended barrel having a hollow needle mounted longitudinally therein having a discharge end and a sharp inlet end, a flexible injection tube communicating with the discharge end of said needle, a replaceable ampoule containing an injection fluid having one end closed with a resilient plug capable of being forced into said ampoule as a piston to discharge liquid therefrom, the sharp end of said needle being adapted to pierce said plug to establish communication between the interior of said needle and the interior of said ampoule during an injection and a plunger in said barrel adapted to thrust said plug into said ampoule during an injection; the process which comprises inserting the discharge end of said flexible tube into a patient, establishing communication between the inlet end of said flexible tube and the discharge end of said needle, mounting the barrel of the syringe on the patient, removing air from said tube and needle, inserting the sterilized end of an ampoule into the open end of said barrel, pressing the ampoule into said barrel thereby injecting the injection fluid into said patient through said tube, leaving said ampoule in thrust home position until time for a second injection, then withdrawing the empty ampoule from the barrel of the syringe, inserting the sterilized end of another ampoule into the barrel, thrusting the ampoule home thereby injecting its fluid into the patient and continuing the described procedure during the period of treatment.

8. In the administration of repeated injections of therapeutic fluids making use of a syringe having a barrel open at one end and with a discharge opening at the other end with a hollow needle mounted longitudinally therein having a sharp inlet end, a flexible injection tube communicating with the discharge opening of said barrel, a replaceable ampoule containing an injection fluid having one end closed with a resilient plug capable of being forced into said ampoule as a piston to discharge liquid therefrom, the sharp end of said needle being adapted to pierce said plug to establish communication between the interior of said ampoule and the interior of said needle during an injection and a plunger in said barrel adapted to force said plug into said ampoule during an injection; the process which comprises inserting the end of said flexible tube into the body of a patient making use of a trocar, removing said trocar, establishing communication between the free end of the tube and the discharge opening of said barrel, securing the syringe to the patient in a position such that accidental withdrawal of said flexible tube from the body is prevented, eliminating air from said injection tube and needle, inserting the sterilized end of an ampoule into the open end of said barrel, thrusting home said ampoule thereby injecting its fluid into the patient, leaving the empty ampoule in position until time for a second injection, withdrawing the empty ampoule from the syringe barrel, inserting the sterilized end of a second ampoule into said barrel, thrusting it home thereby injecting its fluid into the patient and continuing the described procedure during the period of treatment.

9. A syringe for administering repeated injections of therapeutic fluids which comprises a barrel provided with a threaded extension at one end and at the other end being adapted to receive an ampoule during an injection, a hollow needle secured in said threaded extension mounted longitudinally in said barrel, having a sharp inlet end adapted to establish communication between the interior of the ampoule and the needle and a discharge end passing through said threaded extension, said needle being provided with a tapered section adjacent said threaded extension, a flexible injection tube adapted to be slipped over the discharge end of said needle and over said tapered section, and an internally threaded retaining nut having an internal taper corresponding to the taper on said needle adapted to be slipped over said flexible tube and to secure said flexible tube on said taper when tightened on said threaded extension.

10. A device for administering repeated injections of therapeutic fluids which comprises in combination an injection syringe having a barrel which is open at one end and provided with a discharge opening at the other end, means for securing said barrel to the body of a patient, a replaceable ampoule containing an injection fluid adapted to slide into the open end of said barrel, said ampoule having a discharge end normally closed by a resilient plug, a hollow needle mounted longitudinally in said barrel with an end adapted to pierce said resilient plug to establish communication between the injection fluid in the ampoule and the discharge opening of said barrel when said ampoule is pressed into said barrel, means mounted in said barrel adapted to push said plug into said ampoule as said ampoule is pressed into

said barrel during an injection to thereby discharge the fluid in said ampoule into said needle and out of said discharge opening, a flexible injection tube having one end adapted to dwell in the body of a patient during a period of treatment, and means for holding the free end of said injection tube in communication with the discharge opening of said barrel.

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