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SYRINGE FOR HYPODERMIC MEDICAL INJECTIONS

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Fig.1

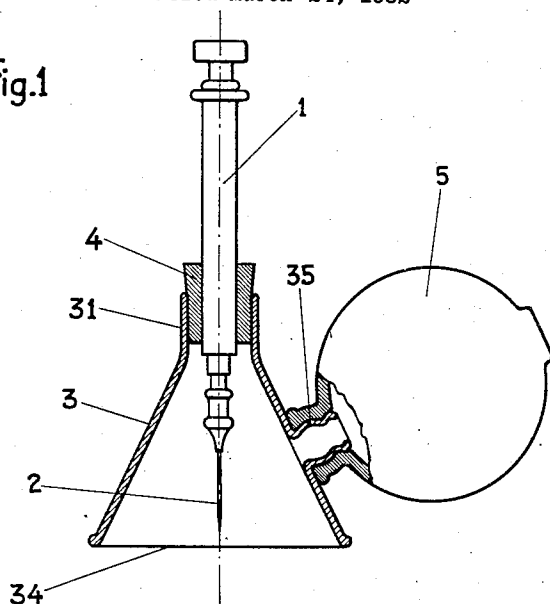


Fig.2

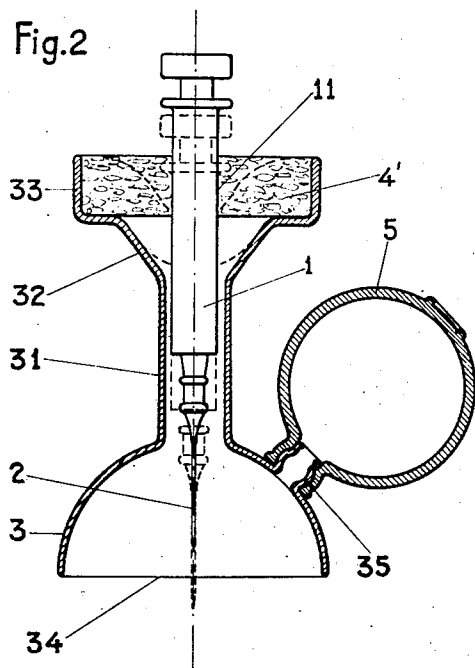
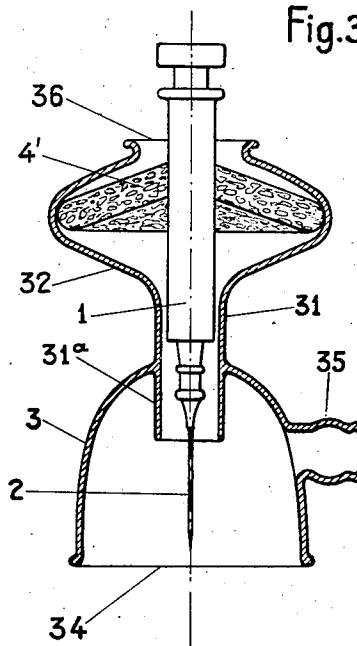


Fig.3



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SYRINGE FOR HYPODERMIC MEDICAL INJECTIONS

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9 Claims. (Cl. 128—215)

This invention relates to syringes, the so-called Pravatz syringes, for hypodermic or endomuscular injections of medical media, and has for its object to provide an automatic device (which will be called hereinafter, for the sake of brevity, the automatic syringe) which will automatically perform the insertion of the needle in, or the withdrawal thereof from the skin of the patient.

It is known that medical injections have required for some time a very large diffusion, and that there are patients who continually make use of said injections, that is every day or even many times a day; here are to be particularly cited the diabetics for the continuous use made by them of the injections of insulin. In order to allow the syringe of Pravatz to be used by the patient himself, and to render its use easy and safe, several types of automatic syringes have been proposed. These syringes generally comprise a spring device, operated in different ways and comprising different details, by which the automatic and instantaneous insertion of the needle into the skin, and in some types also the withdrawal therefrom, are obtained.

In all the types heretofore in use, however, some drawbacks are to be remarked, such as the disagreeable impression produced in the patient by the noisy trip of the spring, the rough operation of the device—which, in the case of an obstacle being met can involve the breaking of the needle—and, in types in which the withdrawal of the needle is made by hand, the possibility of this operation being made in a slanting direction, thus causing a creeping wound to be produced by the point of the needle under the skin.

The automatic syringe according to this invention avoids the above-mentioned drawbacks, the operation of same being absolutely noiseless and being performed, although very rapidly, without any rough trip; the operation of this syringe is very near to that of a syringe used by hand, when the operation is quickly performed by a skilled person. By this syringe both the insertion and the withdrawal of the needle are automatically obtained.

According to this invention, the insertion of the needle into the skin and the tissues which lie beneath, as well as the withdrawal therefrom, are obtained by making use of the atmospheric pressure, the pressure existing in a small cup-like or bell-shaped chamber which is applied locally to the skin of the patient, in the point where the injection will take place, being caused to vary for this purpose.

The automatic syringe is provided with a small chamber, or bell, of glass or other suitable material, the opening of which is applied to the skin; at the top of the bell is fitted the body of the syringe proper, the end thereof which carries the needle being contained in the bell and the needle being directed against the skin, its point, in the initial position, being at a small distance therefrom. The syringe proper can be fitted to the top of the bell in different ways, as it can be positively fixed there or be mounted there by means which allow it a free movement, between given limits, in the axial direction; in any case the fitting must be air-tight. A suitable means, such as a common rubber bulb, having a strong enough structure, allows of the air contained in the bell being sucked out therefrom, so as to produce therein, at the required instant (when the apparatus is being applied to the skin the bell is closed) a considerable vacuum. Owing to the atmospheric pressure, a suction of the tissues of the patient into the bell's mouth is then produced, the tissues assuming a convex form. While on the other hand, if the syringe is given a free movement, a forward stroke of the syringe proper towards the interior of the bell, that is towards the skin, takes place.

If the syringe is steadily fixed to the bell, as the said syringe is stationary, the insertion of the needle is caused by the forwarding against it of the tissues of the patient, the first of the above mentioned effects being so only utilized; when on the contrary the syringe is given a free movement, the effect of this movement is added to the above-mentioned effect, a deeper insertion of the needle into the tissues (endomuscular injections) being thus obtained. In both cases it should be noticed that the temporary swelling of the tissue is of assistance to the insertion of the needle. According to experience the operation causes no disturbance to the patient, as it is painless and substantially not perceived by him.

Three embodiments of the automatic syringe according to this invention are hereinafter described by way of example, with reference to the accompanying drawing, in which Figs. 1, 2 and 3 illustrate each a suitable form, in lateral view, partially in section.

Referring first to Fig. 1, 1 is the syringe proper, 2 is the needle, 3 is the bell, of glass, in the form of a reversed funnel, provided with a lateral connection pipe 35 which is fitted with a rubber bulb 5. The bell has at its top a neck-like aperture 31 in which the syringe 1 is secured, being

fixed there by an air-tight joint such as by means of an apertured rubber plug 4.

In operation, after having manually compressed the rubber bulb 5, the bell's mouth 34 is applied on the skin, on the point where it is required to execute the injection (the skin having naturally been previously cleansed and disinfected and the syringe filled with the medical medium); the bulb is then released, and spreading out instantly, on account of its own elasticity, it will cause a suction of air in the bell 3 and then a vacuum therein. As a consequence of the external atmospheric pressure a suction of the tissue of the patient, in the form of a calotte projecting in the bell, will then take place, and thus the insertion of the needle into the skin. After the injection proper has been performed, it will suffice to compress again the bulb to obtain the return of the tissue to its initial position, the needle being thus withdrawn. The insertion as well as the withdrawal of the needle take place in a direction perfectly perpendicular to the surface of the skin, the rest of the bell thereon serving to determine in the most certain way the normal position of use of the syringe.

Referring now to Fig. 2, there is illustrated a form of automatic syringe wherein the syringe proper is given a certain possibility of axial movement, in order to allow deeper injections to be performed. The bell 3 which in this case has been shown in the form of a spherical calotte, provided with the rubber bulb 5 already described mounted on the connection pipe 35, has at the top a neck 31 through which passes with a suitable play the syringe 1 and which extends above in the form of a funnel 32 limited by a cylindrical seat 33 to which a thick disc 4' of a soft and elastic material, such as spongy rubber or the like, is fixed by its edge; the disc has a hole 11 at the centre through which passes in an air-tight manner the cylinder of the syringe. Under normal conditions, the disc 4' keeps the syringe in the position shown, wherein the point of the needle 2 is at a certain distance from the plane of the mouth 34; when, however, the atmospheric pressure acts from the exterior upon the disc and the syringe, being no longer balanced by an equal pressure in the interior of the bell, the disc 4' bends down as indicated by dotted lines and the syringe assumes the position also indicated by dotted lines. The funnel-like form of the upper extension 32 of the bell assists the piling therein of the elastic material of the disc and so the constitution of an efficient support for the syringe at the end of its stroke.

The operation of the syringe is obvious. As soon as the rubber bulb 5 spreads out, thus producing a considerable vacuum in the bell, the syringe is forced forward by the atmospheric pressure against the skin, causing the needle to penetrate therein, whilst the simultaneous suction of the tissue into the bell takes place, both effects thus co-operating to produce a greater depth of penetration.

Referring to Fig. 3, there is illustrated a modified form which is substantially equivalent to the preceding one so far as the structure and operation are concerned. The same parts already cited in connection with Fig. 2 are to be found here and are indicated by the same reference numbers (the rubber bulb has been omitted); a difference to be noticed is the form of the neck 31 which extends internally of the bell 3 for a length 31a while at its top the said neck spreads into a container 32 having sub-

stantially the form of a double cone, provided with a wide upper aperture 36. The neck 31 together with its projecting portion 31a effectively serves to limit, to a suitable extent, the lateral play of the cylinder of the syringe 1. The disc 4' of spongy rubber, or the like, can be of less thickness than in the preceding case, and does not require to be fixed to the seat by its edge, being cut with a diameter considerably greater than the seat in which it is fitted so as to require forcing therein; besides, on account of the condition of compression wherein the disc is maintained, it will tend to reach either of its two extreme positions bending upwardly (as shown) or downwardly, thus assisting the complete performance of the stroke the syringe is caused to effect by the atmospheric pressure.

A further advantage of the automatic syringe according to this invention will be easily observed from the foregoing description in the fact that, on account of the particular form of the apparatus, the needle will be effectively protected against casual contact with foreign objects, especially after having been sterilized before use. The syringe can also, if required, be kept resting with its bell on a suitable container or on a table on which a small glass is placed, so that the needle be continually immersed in an antiseptic solution, thus being ready for immediate use even a considerable time after its sterilization.

Obviously various modifications can be introduced in the construction of the embodiments described without departing from the scope of the invention. The form of the bell can particularly be varied in every way, and the connection between the top of same and the syringe proper, the positive connection as well as the flexible one, can be obtained in many different ways as will be easily conceived by those skilled in the art. The means used for the suction of the air can also be different.

I claim:

1. The combination, with a hypodermic syringe and its needle, of an attached open mouthed suction chamber, the needle being disposed within the chamber with the point directed towards the mouth, and means for varying the air pressure in said chamber, so that the tissue of a member, over which the chamber may be positioned to cause the mouth to be closed by the member, may be automatically pierced by the needle as a result of relative movement which may be effected between the needle and the tissue by reducing the air pressure in the chamber.

2. The combination defined by claim 1, of which the suction chamber comprises a neck-like portion into which extends the end of the syringe which carries the needle, a bell-like portion flaring downwardly and outwardly to the mouth of the chamber, and air sealing means closing the joint between the syringe and a surrounding part of the chamber wall above the bell-like portion.

3. The combination defined by claim 1, of which the means for varying the air pressure comprises a resilient bulb and a conduit connecting the bulb with the chamber.

4. The combination defined by claim 1, of which the suction chamber has a neck-like portion of reduced diameter between its mouth and its opposite end into and through which the end of the syringe which carries the needle may be moved, an upwardly and outwardly flaring portion above the neck-like portion, and an air seal

comprising a resilient diaphragm closing the space between the syringe and the surrounding wall of the suction chamber at a level above the neck-like portion, the syringe being held in a definite position with respect to the surrounding portion of the diaphragm and limited in its downward movement, when air pressure in the chamber is reduced, by engagement of the diaphragm with the underlying flared wall of the chamber.

5. The combination defined by claim 1, in which the syringe is carried by a diaphragm of resilient material which forms a flexible portion of the walls of the chamber, the said diaphragm being conical in form and having an inherent tendency to carry the syringe to its lowermost position when the center of said diaphragm is forced below the plane of its outer edge.

6. The combination defined by claim 1, of which the suction chamber has a neck-like portion of reduced diameter between its mouth and its opposite end into and through which the end of the syringe which carries the needle may be moved, a portion extended above the neck-like portion flaring upwardly and outwardly and then upwardly and inwardly to form a diaphragm chamber and a diaphragm to seal the space between the syringe and the surrounding wall of the diaphragm chamber, the diaphragm comprising a disk of resilient material of such dimensions as compared with those of the diaphragm chamber as to be compressed and distorted into a conical form, the syringe being movable with the central part of the diaphragm and

normally held thereby in its uppermost position, the diaphragm serving as a means for rapidly moving the syringe to its lowermost position after the diaphragm has been moved past an intermediate dead center position by reduction of air pressure in the suction chamber.

7. The combination defined by claim 1, of which the syringe forms part of a resilient closure for an opening in the wall of the suction chamber whereby a limited movement will be imparted to the syringe to advance the position of its needle when pressure within the chamber is reduced.

8. The combination defined by claim 1, of which the suction chamber comprises a neck-like portion into which extends the end of the syringe which carries the needle, and air sealing means closing the joint between the syringe and the surrounding wall of the neck-like portion.

9. The combination defined by claim 1, of which the suction chamber has a neck-like portion into and through which the end of the syringe which carries the needle may be moved, an upwardly and outwardly flaring portion terminating in an annular diaphragm seat above the neck-like portion, and a resilient diaphragm normally in the form of a disk connected with the syringe and secured in said seat, the syringe being movable with the central portion of the diaphragm when pressure in the chamber is reduced and the degree of movement being limited by contact of the diaphragm with the underlying flared wall of the chamber.

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