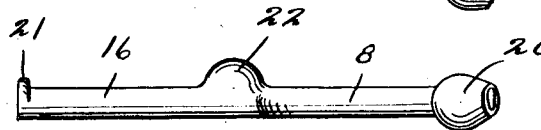
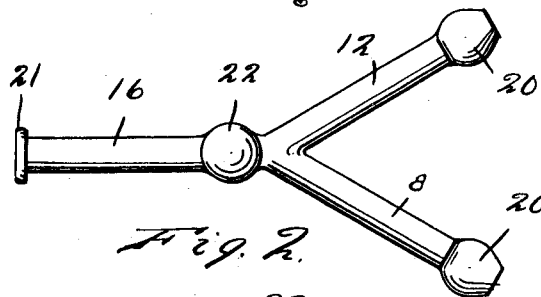
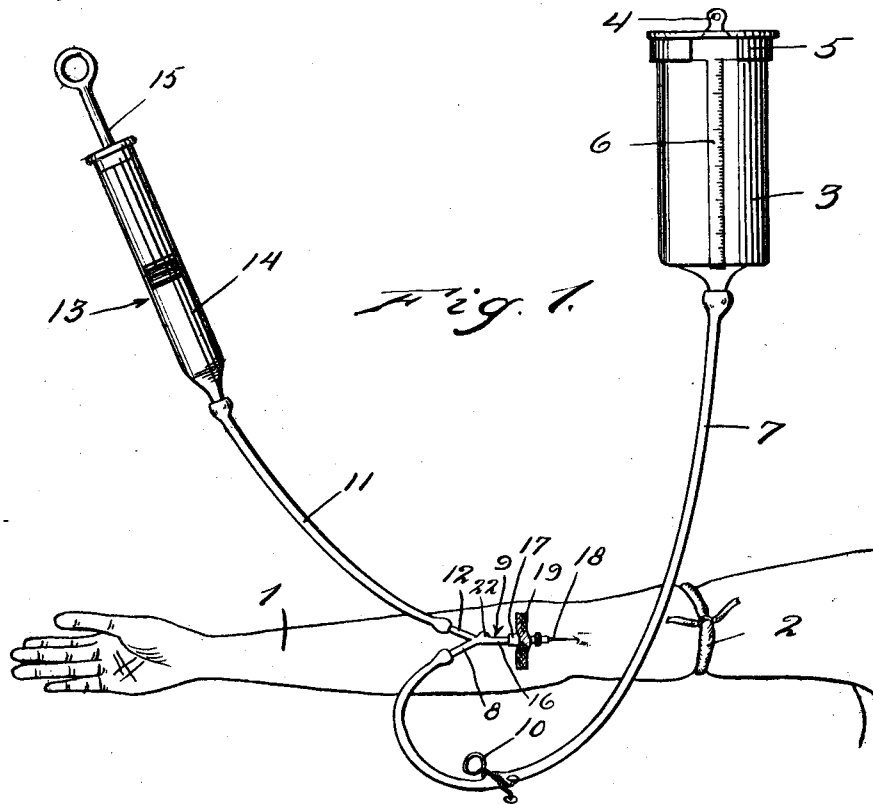


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GRAVITY AND SYRINGE APPARATUS FOR INTRAVENOUS INJECTION OF DRUGS.
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To all whom it may concern:

Be it known that I, MORRIS ABRAMOVITZ, an intended citizen of the United States, residing in Baltimore city, in the State of Maryland, have invented certain new and useful Improvements in Gravity and Syringe Apparatus for Intravenous Injection of Drugs, of which the following is a specification.

My invention relates to a combined gravity and syringe apparatus for the intravenous injection of drugs into the body, and has particular reference to the injection of salvarsan for the treatment of syphilis.

Within recent years much attention has been given to the intravenous injection of drugs and to the provision of simple, cheap and time-saving apparatus for administering them. Such interest has been stimulated greatly by the comparatively recent discovery by Ehrlich and Hata of the anti-syphilitic remedy called "salvarsan." Inasmuch as the intravenous method of injection of this drug has been found in practice to be the least painful and most efficacious, efforts have been directed toward the perfecting of requisite apparatus and method for its administration. All the various types of apparatus devised for this purpose have utilized either the gravity method, or the syringe method. In the former method gravity alone is depended upon to propel the fluid from a highly suspended container through a suitable tube connected with a needle inserted into a vein. In the syringe method the propelling force is obtained by the pressure of the piston of a syringe upon a column of fluid contained within the barrel of the syringe which is connected with the inserted needle. All the previous appliances involve either of these principles, though of course the details of construction of the apparatus have differed in some respects in view of their complexity or simplicity. There are many objections to both of these methods which are readily seen and realized by those having occasion to use them in experimentation or practice. A seriously objectionable feature of the gravity method is the amount of time consumed during the process of injection. The flow of liquid through a hypodermic needle by means of gravity is necessarily small and slow, and the propelling force diminishes with the diminution of the liquid in the ele-

vated container. Complete stoppage of the flow may occur, particularly toward the end of the injection, by the reflex vaso-constriction of the vein, caused by the irritation by the salvarsan, producing a pressure in the vein sufficiently high to overcome the gravity force. In this contingency blood clots might form in and around the needle. Furthermore the proper entrance of the needle into the vein is with difficulty ascertained, even when a piece of glass tubing is interposed between the end of the supply tube and the needle, as one must rely entirely upon the back pressure of the blood in the vein to displace the liquid in the glass tube in opposition to the gravity propelling force, and this pressure of the blood is insufficient. Some appliances have a detachable needle which is disconnected from the tubing allowing the blood to flow to indicate a successful puncture of the vein. The great disadvantage of this is that during the act of then attaching the tubing to the needle, the needle may be jarred and forced through the lower wall of the vein causing a leakage of the liquid into the tissue, which would cause, as experience has shown, extreme swelling of the tissue. Also during the act of attaching the tubing air bubbles might enter the needle and be forced by the liquid into the circulation subjecting the patient to the danger of an air embolus.

The syringe method has as many disadvantages. Most syringes adapted for use in this particular operation have metallic parts particularly a two-way stop cock. As salvarsan is quickly oxidized as well as oxidizing its passage through such a syringe would form poisonous oxids which would be injected into the patient's blood. In addition to this, such a syringe may be used on the left arm as in this position the stop cock would be on top and accessible, but its use on the right arm is inconvenient as the stop cock would be necessarily on the bottom and difficult of access.

The operation of retracting the piston of the syringe in order to ascertain the proper entry of the needle into the vein naturally draws the blood into the syringe, part of it adhering to the walls and clotting. When the liquid is then injected the clots will either clog the needle entirely or pass into the circulation. This likewise causes danger of an embolus. As the capacity of a syringe is

ordinarily no more than fifty c. c. it is necessary to interrupt the injection frequently in order to refill the barrel. The time then consumed in closing the stop cock, filling the barrel and opening the stop cock is frequently sufficient to cause the formation of blood clots. Furthermore air may enter and be injected, causing great danger to the patient. An assistant is indispensable, which adds another disadvantage to this method, as it increases the cost to the operator and the patient.

The object of the present invention is to provide an apparatus which will combine in one device the syringe and gravity methods, obviating their objectionable features.

Another object is to provide a device of this character which will insure a continuous flow of liquid.

An important object is to provide a device which is capable of injecting liquid at gravity pressure and a pressure higher than gravity without any cessation of the flow.

A further object is to provide a device of this character in which the entry of the needle into a vein may be ascertained without danger of the formation of a blood clot.

Still another object is to provide a device of this character in which the needle is held rigid upon a patient preventing movement of the needle and puncturing of the walls of the veins.

A further object is to provide a device of this character which is expeditious in operation, and capable of being handled by one operator.

A very important object is the provision of a device of this character having one of its elements adapted to serve as an air trap to prevent the injection of air bubbles into the vein.

Other objects and advantages such as cheapness and simplicity will appear in the course of the specification.

Referring to the drawings forming a portion of this specification and in which similar numerals are employed to designate corresponding parts throughout the several views: Figure 1 is a general view of my improved apparatus illustrating its use, Fig. 2 is a plan view of a specific cannula used in connection therewith, and Fig. 3 is a side elevation of the same.

Referring more particularly to the drawings, 1 represents the arm of a patient to be treated, and 2 indicates a tourniquet applied thereto.

The numeral 3 designates a container of any desired size and formed preferably of glass. The container is adapted to be supported by means of a hanger formed on a ring 5 encircling the container. Graduations may be marked on the container itself, but on account of cheapness I prefer to use an unmarked container, and employ a gradu-

ated rod 6 formed on the ring 5 and extending longitudinally to the bottom of the container.

A flexible tube 7 preferably of rubber is connected with the container 3 and one branch 8 of a specially constructed Y cannula 9. A pinch cock 10 is disposed upon said tube 7. A second tube 11 is connected with the other branch 12 of said cannula and a glass syringe 13, comprising the barrel 14 and piston 15. To the main lumen 16 of said Y cannula 8 is connected by means of a tube 17, a hypodermic needle 18 of any well known or preferred type. The cannula and needle are adapted to be secured in place upon the arm by means of a strip of adhesive plaster 19.

The cannula 9 is an important part of my invention as it is designed to serve as a trap for any air that may be in the apparatus. The branches 8 and 12 have their ends corrugated or provided with bulbous protuberances 20 for attachment with the rubber tubes 7 and 11, while the main lumen 16 has a perfectly cylindrical bore with merely a projection 21 upon the upper edge of its end to engage the tube 17 firmly. Upon the main lumen 16 near its union with the branches 8 and 12 is formed a bulb 22 which projects above the cannula and beyond its sides, thus making it of greater diameter in every way than the bore of the cannula. In practice I have found it advisable to make the bulb 22 of about 2 c. c. capacity. It will be understood that all parts of the apparatus in contact with the liquid used are of glass or rubber, except the needle.

The operation of my apparatus is as follows: After sterilization, the container 3 is filled with distilled water and suspended from a gravity pole. By opening the pinch cock 10, the water is allowed to run through tube 7 and out driving out the air from this portion of the apparatus. The pinch cock 10 is then closed. The barrel 14 of the syringe is then filled with distilled water and the air driven out by pressing the piston 15 upward. Then the connections with the Y cannula 9 are made as illustrated. By lowering the cannula and opening the pinch cock 10 the air is driven out of branch 8 of the Y. The piston 15 of the syringe 13 is now pressed forward driving water and thus the remaining air out of the branch 12 of the Y and the main lumen 16. The apparatus freed of air is then ready for use. The tourniquet 2 is then applied to the arm as shown, and after the veins have distended the needle 18 is inserted. A successful puncture is indicated by a reflex column of blood in the base of the Y 9. As soon as this is noted, the cannula 9 is secured upon the patient's arm by means of the adhesive strip 19 placed at the junction of the Y with the needle. The tourniquet is then removed.

With the pinch cock 10 closed the piston 15 is forced downwardly slowly thereby re-injecting the blood into the vein and introducing water. Meanwhile the solution, such as salvarsan, has been poured into the receptacle 3 with what water remained therein. When the syringe is emptied of water, it is refilled by opening the pinch cock 10 and pulling back the piston 15, slowly. When the syringe 13 has been refilled the pinch cock 10 is closed and the contents of the syringe expelled into the vein. This is continued until the container 3 is empty, or until the desired amount has been injected.

If any bubbles of air have found their way into the apparatus from leakage or any other cause, they will rise to the top of the bulb 22 and the liquid will pass out through the Y leaving the bubbles caught in the bulb 22.

Experiment has proved that when the piston is drawn back to refill the syringe the cavity formed by the bulb 22 being above the level of the main lumen not only serves as a trap for the air bubbles but also is more or less filled with the liquid from the container and with the air, if any therein, produces a gravity pressure which with the gravity pressure of the container forces a steady flow of the liquid through the needle while the syringe is being filled, whereby the blood is prevented from entering the needle during the operation of refilling the syringe. Thus it is seen that at no time is there any stasis in the system. The importance of this steady current can not be overestimated, since it prevents the formation of clots and the clogging of the needle during the refilling of the syringe.

The bulbous portion 22 of the cannula is a positive safeguard against the passage of bubbles into the vein, as they are bound to rise within the bulb and remain there while the liquid flows continuously through the cannula.

By combining a gravity fluid propeller with a syringe or hand forced fluid propeller in the manner described into a one unit force I effect a continuous flow through the needle whereby the syringe may be refilled without breaking the continuity of the flow through the needle and thereby preventing the blood entering the needle while the syringe is being refilled.

With my apparatus all of the fluid or solution may be withdrawn from the container and the operation performed in a few minutes while with the gravity method alone the operation is very slow, and the gravity pressure becomes gradually less, as the quantity of the solution becomes reduced, until it becomes too weak to overcome the reflex vaso-constriction of the vein, when the flow ceases and a considerable portion of the solution remains in the container.

Furthermore, the transparency of my Y tube, one arm of which is connected with the tubing from the solution container, enables the operator to see when the tubing is completely empty by noticing the air coming down in the arm of the Y tube. This transparency of my Y tube also enables the operator to see if the needle is in the vein, by drawing the piston of the syringe slightly when the puncture is made until the blood appears directly in front of the needle, and to then immediately inject it back into the vein before it becomes clotted. Furthermore, with my apparatus one person can carry out the entire operation, thus dispensing with an assistant or the presence of an assistant, and it can be applied equally well to either the right or left arm.

Having thus described my invention what I claim is:

1. An intravenous injector comprising a gravity reservoir, a syringe, a common outlet provided with a hollow upwardly extending protuberance and connected with said reservoir and said syringe, and a hypodermic needle connected with said common outlet.

2. An intravenous injector comprising a Y, a gravity reservoir connected with one branch of said Y, a syringe connected with the other branch of said Y, a hollow upwardly extending bulb on said Y, and a hypodermic needle connected with the main lumen of said Y.

3. An intravenous injector consisting of a gravity reservoir, a Y tube, a hollow upwardly extending bulbous projection on said Y tube, a tube connecting said reservoir with said Y tube, a cut off device disposed on said second mentioned tube, a syringe, another tube connecting said syringe with said Y tube, and a hypodermic needle connected with said Y tube.

4. An intravenous injector consisting of a gravity reservoir, a Y tube, a tube connecting said reservoir with said Y tube, a cut off device disposed on said second mentioned tube, a syringe, another tube connecting said syringe with said Y tube, and a hypodermic needle connected with said Y tube, said Y tube being provided with an enlarged hollow upwardly projecting portion between the fork of said Y tube and the end of the main lumen.

5. In an intravenous injector, the combination of a gravity reservoir, a Y tube, a tube connecting said reservoir with said Y tube, a cut off device disposed on said second mentioned tube, a syringe, another tube connecting said syringe with said Y tube, and a hypodermic needle connected with said Y tube, said Y tube being provided with an upwardly extending hollow projection between the junction of the branches and its connection with the needle.

6. In an intravenous injector, comprising a gravity reservoir, a syringe and a hypodermic needle; a Y tube having its branches connected with said reservoir and said syringe and its main lumen connected with said needle, said Y tube being provided with a hollow upwardly extending projection between the fork and the end of the main lumen. 15
7. In an intravenous injector, comprising a gravity reservoir, a syringe and a hypodermic needle; a Y tube having its branches connected with said reservoir and said syringe and its main lumen connected with said needle, said Y tube being of transparent material and provided with a hollow upwardly extending projection between the fork and the end of the main lumen. 20
- In testimony whereof I hereto affix my signature in the presence of two witnesses. 20
- MORRIS ABRAMOVITZ, M. D.
- Witnesses:
SOL. H. EMANUAL,
HENRY W. BATEMAN.