

[54] FLUID DISPENSING DEVICE

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[58] Field of Search 128/214 R, 214 C; 137/433

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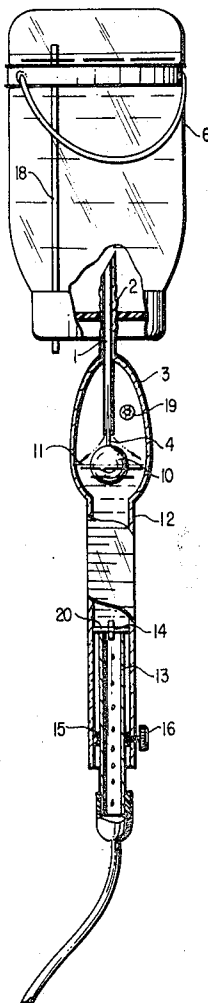
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[57] ABSTRACT

A fluid flow regulating device for insuring a constant rate of flow therethrough, suitable for use in intravenous therapy, including a constant fluid level chamber with an adjustable piston having a drip orifice in the head thereof seated within and forming the bottom of the chamber. The top portion of the chamber has a fluid receiving tube seated therein. A buoyant body having an upwardly projecting member is located within the chamber and is received within said fluid receiving tube, with at least a portion of the projecting member conforming in shape and size to the orifice of the fluid receiving tube so as to occlude the orifice when in contact. The hydrostatic head pressure is kept constant within the constant level chamber, thereby providing a constant flow rate which can be adjusted over wide ranges by moving the piston up or down to vary the height of the liquid column in said chamber.

9 Claims, 3 Drawing Figures



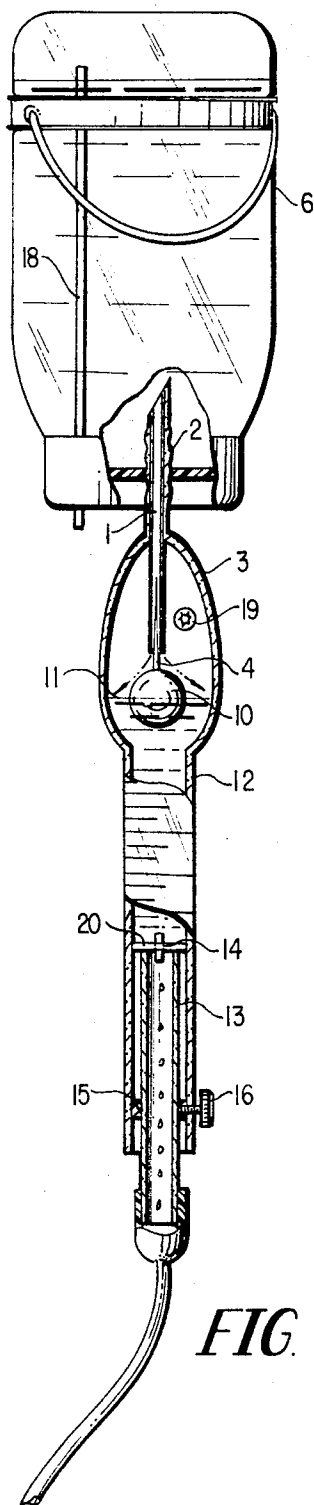


FIG 1

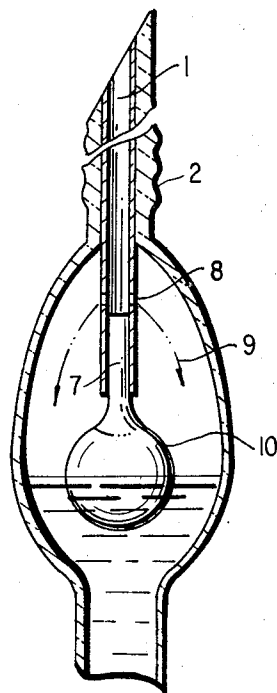


FIG 2

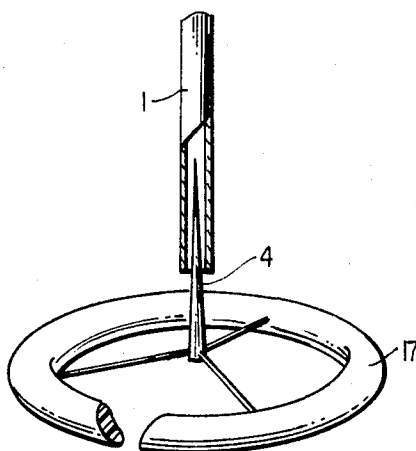


FIG 3

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FLUID DISPENSING DEVICE

BACKGROUND OF THE INVENTION

1. Field Of The Invention

This invention relates to fluid dispensing apparatus and more particularly to a device for dispensing aseptic medicinal fluids. Still more particularly, this invention relates to a device for dispensing fluids intravenously which insures constant flow while providing convenient adjustment of flow rate, and in which medicinal solutions may be added to the basic fluids being administered, as desired.

2. Description of the Prior Art

The therapeutic practice of introducing large volumes of fluids such as whole blood, plasma, albumin, balanced salt solutions, amino acids, glucose solutions, etc. and chemotherapeutic agents is well known in the medical art. Such methods generally withdraw an appropriate aseptic fluid from a reservoir by a gravity feed system through a flow indicating device, commonly a drip meter, by which the rate of flow into a flexible conduit usually terminating in either a needle or cannula inside the patient's vein may be observed by counting the number of drops over a given period of time. Typical rates of delivery may vary from 1 liter every two hours to 1 liter every twelve hours, depending on the clinical state of the patient.

The gravity flow is generally regulated by a suitable clamp on the conduit leading from the flow indicating device to the patient. Since the average blood volume in a human is on the order of 5 liters, careful control is needed in administering large volumes of fluid to avoid a sudden surge in the blood volume. It is usually desirable to limit fluid administration rates to less than 1 liter per hour. As fluid is administered, the hydrostatic head pressure in the reservoir changes due to a decreased fluid level therein, thereby gradually slowing the rate of delivery. When the hydrostatic head pressure is no longer sufficient to overcome the resisting pressures from the clamp and the patient's venous pressure, fluid delivery ceases until the clamp is loosened, the reservoir raised, or both. Particularly when using a slow rate of flow, which is often desirable, this process may recur often in the course of administering a single bottle of fluid. Even with frequent supervision and adjustment, patients get too much volume for awhile and then too little. If the fluid delivery rate declines below the acceptable limit or stops, clots may form which clog the needle in the vein, requiring the fluids to be re-started in another vein. Such interruptions are a nuisance to the attending medical staff which must frequently check and adjust the rate of flow, and to the patient, who is often uncomfortable during the course of parenteral therapy since he must be immobile at the point of needle insertion to avoid pulling it out prematurely. At worst, such an errant method of delivery could seriously hinder needed therapy by constantly slowing down and stopping. Since the rate and regularity of fluid administrations are often of prime importance, this process has serious drawbacks in being inherently unreliable and irregular in flow rate over a period of time.

Another problem in intravenous fluid dispensing devices for medical use arises when it becomes necessary to change bottles of solution being administered. It is desirable to be able to do so while disturbing ongoing intravenous therapy as little as possible, and care must be taken so that no air enters the delivery tubing because of danger to the patient of an embolism. Due to the capillary pressure along the walls of the relatively small diameter delivery tubing, air entering the tube will not bubble through a liquid layer forced in on top thereof, but will be compressed slightly and forced on through the tubing and into the patient. It is therefore of utmost importance that air be excluded from the tubing when a delivery bottle runs dry or when solutions are being changed.

Yet another difficulty with known intravenous dispensing devices arises when it becomes necessary to administer medication intravenously in concentrated form. Many drugs are suitable for only intravenous administration, and this route is

often used for other drugs where rapid delivery is desired. Of course, if concentrated and rapid delivery are not needed, such medication can be mixed with the parenteral solution in a bottle (usually 500 to 1,000 ml. of parenteral solution) and delivered gradually in the thus-diluted form. Since it is seldom advisable to infuse more than one liter of total volume every two hours, and often much slower rates are desirable depending on the clinical state of the patient, it becomes necessary to either discontinue intravenous therapy in order to inject medication through the tubing with attendant chances of forming air bubbles therein, or to enter another vein to administer the medication. Since even young, normal, relatively healthy patients have only a limited number of vein sites which may be used for intravenous injections, and since a site once used should ideally not be used again for several days, the more conservative medical approach is often to use the needle which is already in a vein, in spite of the attendant disadvantages.

SUMMARY OF THE INVENTION

It is the general purpose of this invention to provide a fluid regulating device for delivering fluids at a constant rate having all of the advantages of similarly employed prior art devices with none of the above described disadvantages.

An object of this invention is to provide a device for dispensing aseptic fluids intravenously which insures a constant flow rate throughout the course of fluid delivery from a reservoir.

Another object of this invention is to provide a device by which a desired flow rate may be conveniently adjusted without the necessity of moving the reservoir container.

A further object of this invention is to provide an apparatus for regulating flow rates of intravenous solutions without the necessity of regulating clamps on the delivery tubing.

An additional object of this invention is to provide a device for delivering and regulating the flow rate of intravenous fluids which need not be interrupted for the intravenous administration of additional medication, solution, or the like.

Another object of this invention is to provide a flow regulating device for delivery of intravenous solutions which provides easy means of changing bottles without interrupting fluid delivery.

A still further object of this invention is to provide a fluid dispensing apparatus which substantially eliminates the possibilities of an air embolism being passed therethrough when the reservoir runs dry or when changing reservoirs.

Yet another object of this invention is to provide a fluid regulating device suitable for use with intravenous solutions which provides a constant fluid delivery rate which may be regulated within wide limits.

The foregoing and other objects are attained in accordance with the present invention which provides a unique fluid dispensing apparatus having an elongated cylinder containing a piston for setting a hydrostatic head suitable for the desired rate of delivery, a float having a conical upwardly protruding member which moves vertically within a metal delivery cylinder projecting downwardly from the reservoir in response to changing fluid levels, thereby automatically maintaining a constant fluid level within the elongated cylinder and a correspondingly constant flow rate. If desired, a port covered with rubber or similar material may be provided at the upper end of the chamber to permit injection of additional medication for administration through the intravenous setup.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the invention will become more fully apparent to those skilled in the art from the following description of an illustrative embodiment of the invention, as shown in the annexed drawings, wherein like reference characters designate like or corresponding parts throughout the several Figures, and in which:

FIG. 1 is a side view, partially in section, of the flow regulating device of this invention, shown inserted into a suitable reservoir bottle;

FIG. 2 is a detailed view of the constant level chamber, showing a variation in design of the cylinder and elongated cone;

FIG. 3 shows a modification of the buoyant float device.

DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

Referring now to FIG. 1, the fluid dispensing device of the present invention is shown inserted into a suitable reservoir 6 of fluid to be administered, having an air vent 18 therein to prevent the formation of a vacuum as the fluid is dispensed, as is customary with such bottles. Penetrating the rubber cork of the bottle 6 is a tubular cylinder 1 which is sealed within a corrugated covering 2 of plastic or the like so as to allow the cylinder to gain a purchase in the rubber cork. The plastic cover is shown as an extension of a constant level chamber 3. The tubular cylinder, of metal or other suitable material, extends downwardly into the constant level chamber and encircles an elongated cone 4 which is small enough at the tip portion to freely enter the cylinder 1 but large enough at an expanded diameter section to block the downward flow of fluid from the bottle 6 after having entered a short distance. The elongated cone 4 is mounted on a buoyant member 10, which moves the cone up or down in response to changes in the fluid level 11.

The function of cone 4 may also be provided by other means, such for example as a solid elongated cylinder 7, as seen in FIG. 2. In such a modification, the tubular cylinder 1 may be provided with a plurality of perforations 8 at the lower end thereof which would allow the exit of fluid 9 when solid elongated cylinder 7 has moved sufficiently downward.

Constant fluid level chamber 3 includes a lower portion, illustrated as a hollow cylinder 12, which may be integrally formed therewith and which houses a piston 13 therein. Piston 13 forms a fluid tight seal with the inner wall of cylinder 12 by means of a circular piston head 20 containing a drip orifice 14. Since the rate of fluid flow through the drip orifice is determined by the hydrostatic pressure of fluid above the orifice, which is adjustable by moving the piston and constant once the piston is positioned, it is the hydrostatic head within the constant level chamber which determines the rate of flow, rather than the hydrostatic head within the reservoir bottle.

At the lower end of cylinder 12 is a shelf 15 which keeps piston 13 centered. The shelf may encompass the entire piston, or only a portion thereof. Directly in alignment with the shelf 15 is a setscrew 16 which may be tightened to position the piston 13 within cylinder 12. Since the piston 13 may be moved up or down within the hollow cylinder 12 and then locked into position, the hydrostatic head within the constant level chamber may be adjusted over a wide range. Cylinder 12 may have calibrated markings to indicate flow rates for a particular solution.

The buoyant member 10 may be of any suitable design, such for example as the sphere illustrated in FIGS. 1 and 2 or a buoyant ring 17, as shown in FIG. 3, with spokes projecting to the centrally disposed cone 4. Such a ring allows the drip orifice 14 to be positioned very close to the fluid level 11, and thereby provides a very slow rate of flow.

As a further modification of the present invention, the constant level chamber may be provided with a rubber port 19, as is well known in the art, whereby a desired amount of medicine can be injected via a syringe and hypodermic needle. After such an injection, the added volume causes the buoyant float 10 to rise, causing the cone 4 to enter further into the tubular cylinder 1, thereby closing off flow from the reservoir. After a volume equaling the injected volume is lost through drip orifice 14, the buoyant sphere will fall, separating the cone from the tubular cylinder, and allowing additional fluid to enter from the bottle 6. The medicine remaining in the constant level chamber 3 will be progressively diluted and ad-

ministered as the flow through drip orifice 14 returns to the pre-set rate with no further adjustments being required.

It will be appreciated that while the foregoing disclosure relates only to a preferred embodiment of the invention in delivering medicinal fluids intravenously for parenteral therapy, it is capable of delivering many fluid materials for various purposes, and will provide a constant rate of flow under different conditions. Accordingly, numerous modifications or alterations may be made by those skilled in the art without departing from the spirit and scope of the invention as set forth in the appended Claims.

What is claimed and desired to be secured by letters patent is:

1. A fluid flow regulating device for insuring a constant rate of flow therethrough by maintaining a selected constant hydrostatic pressure therein, comprising:

- a. a constant fluid level chamber;
- b. means communicating with said chamber for the admission of fluid thereto;
- c. float means in said chamber for controlling the admission of fluid thereto;
- d. means defining a drip orifice through which fluid is dispensed from said chamber, said drip orifice means being arranged for adjustable sliding movement relative to said chamber for varying the hydrostatic pressure within said chamber; and,
- e. means operatively connected between said chamber and said orifice defining means for securing said orifice in a selected adjusted position relative to said chamber.

2. A fluid flow regulating device for insuring a constant rate of flow therethrough by maintaining a selected constant hydrostatic pressure therein, comprising:

- a. a constant fluid level chamber;
- b. a piston having a drip orifice through the head thereof, said piston being arranged for adjustable sliding movement within said constant level chamber and including means operatively connected between said piston and said chamber for securing said piston in a selected adjusted position for varying the hydrostatic pressure within said chamber;
- c. a buoyant member disposed within said constant fluid level chamber and having affixed thereto an upwardly projecting member;
- d. a receiving tube into which said upwardly projecting member extends, said receiving tube communicating with said constant level chamber and extending outwardly therefrom, said tube having an inner diameter conforming to the outer diameter of said upwardly projecting member at at least one portion thereof; and
- e. means for receiving a delivery tube in fluid flow relation with said drip orifice.

3. The apparatus of claim 2 in which the buoyant member comprises a sphere carrying an upwardly projecting conical member.

4. The apparatus of claim 2 further including a plastic corrugated covering over said cylindrical receiving tube.

5. The apparatus of claim 2, wherein said buoyant member includes a buoyant sphere with an integral upwardly projecting closed cylindrical member, and wherein said receiving tube has a perforation defined near the lower end thereof.

6. The apparatus of claim 2, wherein said buoyant member comprises a buoyant ring having spokes projecting toward the center thereof wherein said upwardly projecting member is mounted.

7. The apparatus of claim 2, further including a shelf surrounding at least a portion of said piston, whereby said piston is maintained in a laterally centered position within said constant level chamber.

8. The apparatus of claim 7, further comprising means for adjustably positioning said piston within said constant fluid level chamber to determine the hydrostatic head within said chamber.

9. The apparatus of claim 8, further including means defining a port for injection of fluid into said constant fluid level chamber.

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