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APPARATUS FOR PRECISE ADMINISTRATION OF PARENTERAL FLUIDS

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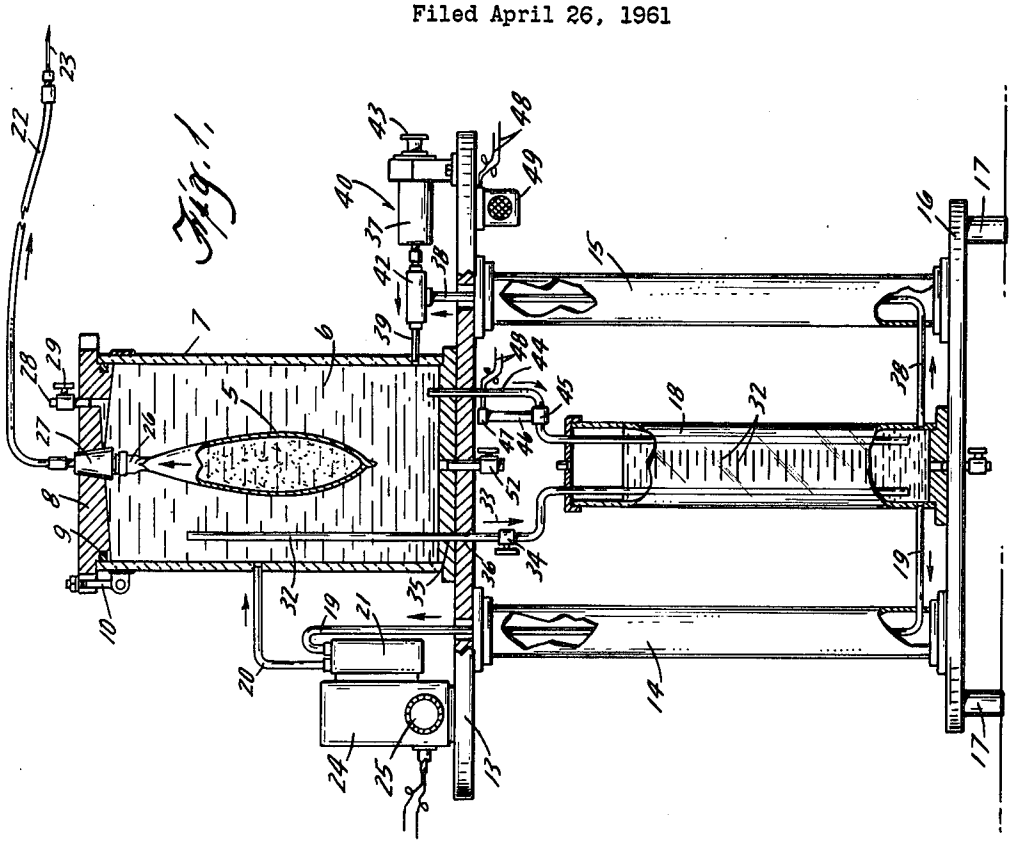
Fig. 1.



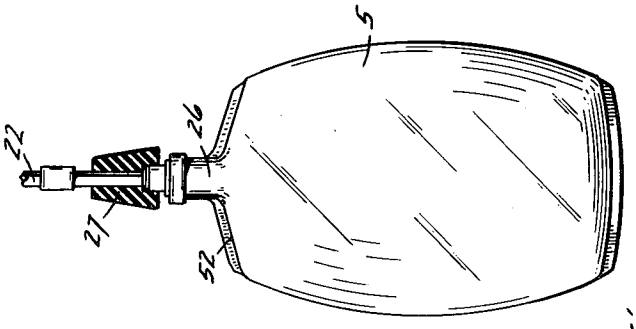


Fig. 2.

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APPARATUS FOR PRECISE ADMINISTRATION OF PARENTERAL FLUIDS

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This invention relates to apparatus for the precise administration of parenteral fluid and the like.

The apparatus of the present invention will enable physicians to administer parenteral fluids, blood and chemotherapeutic agents in definite amounts over a stated period of time. This is particularly important in the administration of such fluids to infants and children and to elderly patients, especially those with cardiovascular or kidney disease. The present invention will help maintain the blood level more evenly when antibiotics are administered parenterally. Vasopressor drugs can be introduced into the blood stream more accurately. The apparatus is of especial value when chemotherapeutic drugs are administered in the treatment of malignant disease. Oxytocic drugs may be administered by the apparatus of the present invention to obstetrical patients.

The apparatus of the present invention is not limited to intravenous administration and it can be used for alimentary tract feedings.

In hospital use of the apparatus of the present invention, it is particularly important that any parenteral fluids be completely sterile. It is a feature of the apparatus of the present invention that absolutely sterile conditions are maintained during administration thereof. Moreover, the flow rate and total quantity of fluid that is administered is positively controlled and limited.

According to the present invention, a positive displacement pump is used to accurately control delivery of measured quantities of fluid. However, none of the parenteral or other fluid whose flow rate is controlled passes through the pump. This avoids any need to sterilize the pump and avoids damage to the pump where the fluids to be administered are corrosive.

According to the present invention a collapsible bag containing the fluid to be administered is immersed in a container of incompressible liquid which completely surrounds the bag. As additional incompressible liquid is pumped into the container at a regulated rate, the fluid will be exhausted from the bag at the same rate for administration to the patient or otherwise.

The apparatus of the invention desirably draws fluid for the pump from a second container which is graduated in terms of the volume of material passing through the pump so that the quantity of material administered can readily be checked simply by reference to said graduations.

Other objects, features and advantages of the invention will appear from the following disclosure in which:

FIG. 1 is a vertical cross section taken through apparatus embodying the invention.

FIG. 2 is an elevation of a preferred form of collapsible bag used therein.

According to the present invention, the collapsible or yieldable wall bag or parenteral fluid container 5 which contains the fluid to be administered is immersed in an incompressible fluid 6, such as water, within a pressure fluid container 7 which has a cover 8 which may be tightly sealed to the container 7. O-ring 9 has been found to produce a satisfactory seal. Cover 8 may also be clamped in place by otherwise conventional swing bolts 10.

In a practical embodiment of the invention, the container 7 stands upon a table top 13 supported on hollow tubular columns 14, 15, which in turn rest upon a base

plate or dolly 16 supported from the floor on caster wheels 17.

Beneath table top 13 and on the plate 16 is a sump or second container 18 for the incompressible liquid 6. Container 18 functions as a supply reservoir for pump 24. Liquid 6 may be pumped from container 18 to container 7 through the conduits 19, 20 and the intervening pump 21 which may conventionally be energized by an electric motor 24 or the like. Pump 21 is of any conventional available type, but must be capable of positive displacement of the liquid 6 and is desirably adjustable as to rate of flow. In a practical embodiment of the invention, the pump 21 has 200 different flow rate settings, the selection of which is made by turning the control dial 25. The flow rates thus selected range between 0.05 cc. to 10.00 cc. of fluid per minute.

The collapsible plastic bag 5 is connected through the top 8 of container 7 to a hose 22 or the like having at its end a conventional injection needle 23 or the like. The bag 5 has a neck 26 connected to a stopper 27 or the like which is firmly seated in a suitable socket in the top 8.

Top 8 is also provided with an air bleed vent 28 under control of the manual valve 29 so that all air can be evacuated from the container 7 prior to operation of the pump.

If pump 21 is operated to transfer liquid from container 18 to container 7 at a predetermined fixed rate, the fluid within collapsible bag 5 will be evacuated therefrom through infusion tube or hose 22 and needle 23 at exactly the same rate. This is highly important in administering parenteral fluids and solves a very definite problem which has heretofore existed when fluids were simply administered by gravity. It is virtually impossible to control the rate of flow in a gravity feed arrangement. Accordingly, the welfare and even the lives of patients were frequently endangered by the uncontrolled flow of such prior art systems.

Container 18 is provided with graduations 32 which are so arranged as to indicate the volume of liquid 6 pumped from chamber 18 to container 7. This will also give an accurate reading as to the volume of fluid evacuated from the bag 5.

After the bag 5 has been evacuated completely, the fluid 6 in container 7 is allowed to drain back into container 18. For this purpose a stand pipe 32 is provided in container 7 and it drains in the direction of arrow 33 into the container 18. During pumping the shut-off valve 34 is closed, but this valve is opened when drainage is desired. During drainage, vent valve 29 is also opened or top 8 removed from the container 7 to relieve the vacuum in container 7.

The top of the stand pipe 32 is ordinarily disposed at a level such that only as much liquid is drained from container 7 as equals the volume of a completely filled bag 5. Pipe 32 is accordingly desirably made slidably adjustable vertically through its sealed openings 35, 36 in the bottom of container 7 and table top 13.

Accordingly, when a freshly filled bag 5 is placed in the container 7, it will displace just about as much liquid 6 as will be required to completely fill the container 7. The valve 29 is left open to permit evacuation of excess air. To insure complete air evacuation, a second pump 40 is provided to pump liquid 6 from container 18 through conduits 38, 39 into the container 7. Pump 40 includes a check valve 42 and manually operated syringe 37 having a hand-operated plunger 43.

The supplementary pump 40 can also be used during the operation of pump 21 if it is desired to increase momentarily the flow of fluid through needle 27. Inasmuch as all liquid for container 7 comes from sump 18, the graduations 32 will give a cumulative indication of

fluid dispensed from the bag 5, whether through pumps 21 or 40.

There is also a pressure relief conduit 44 interconnecting containers 7 and 8. Conduit 44 passes through a pressure sensitive valve 45 which is desirably of the type shown in my United States Patent 2,629,399. The pressure on the valve 45 is provided by a column 46 of mercury. At the top of the mercury column there is a switch 47 in circuit through lines 48 with an alarm horn 49. Accordingly, if the pressure rises in container 7 beyond permissible limits, the valve 45 will open to return liquid from container 7 to container 18 and at the same time, horn 49 will sound to signal the excess pressure condition.

This condition might be caused by stoppage of flow or when the bag 5 is completely evacuated. The liquid flowing through pump 21 will then simply be bypassed or returned through conduit 44 to the container 18. Graduations 32 will still accurately show the quantity of fluid dispensed from bag 5.

A drain cock 52 may optionally be provided in the container 7.

In practical embodiments of the invention, the conduits 19, 38 are desirably concealed within the hollow columns 14, 15.

The collapsible bag 5 can be made of any conventional material available for this purpose, suitable bags of plastic being commercially available. Where parenteral fluids are involved, the bags are sterilized. Where corrosive fluids are involved, the material of the bags is non-reactive therewith. It is desirable that such bags have a top 52 which upwardly tapers toward the neck 26, thus to avoid trapping fluid and to facilitate complete evacuation of the bag.

I claim:

1. Apparatus for the precise administration to a patient of parenteral fluids and the like comprising a parenteral fluid container connected to an infusion tube and needle for connection to and administration of parenteral fluid to a patient, an incompressible fluid container, said containers having a common wall therebetween to isolate the fluids in the respective containers, said wall being yieldable to communicate the pressure in the incompressible fluid container to the parenteral fluid container, a supply reservoir containing incompressible fluid therein, a positive displacement pump connected between the supply reservoir and the incompressible fluid container to pump incompressible fluid from the supply reservoir into said incompressible fluid chamber at a predetermined constant flow rate whereby to expel parenteral fluid from the parenteral fluid container at exactly the same flow rate as incompressible fluid is forced by the pump into the incompressible fluid container and independent of the impedance to flow presented by the connection to the patient.

2. Apparatus for the precise administration to a patient of parenteral fluids and the like comprising a parenteral fluid container connected to an infusion tube and needle for connection to and administration of parenteral fluid to a patient, an incompressible fluid container, said containers having a common wall therebetween to isolate the fluids in the respective containers, said wall being yieldable to communicate the pressure in the incompressible fluid container to the parenteral fluid container, a supply reservoir containing incompressible fluid therein, a positive displacement pump connected between the supply reservoir and the incompressible fluid container to pump incompressible fluid from the supply reservoir into said incompressible fluid chamber at a predetermined constant flow rate whereby to expel parenteral fluid from the parenteral fluid container at exactly the same flow rate as incompressible fluid is forced by the pump into the incompressible fluid container and independent of the impedance to flow presented by the connection to the patient, means limiting the pressure imposed by the pump, said means being responsive to the pressure in the incompressible fluid container and further comprising means to signal when the pressure in said incompressible fluid container exceeds a predetermined setting.

3. Apparatus for the precise administration to a patient of parenteral fluids and the like comprising a parenteral fluid container connected to an infusion tube and needle for connection to and administration of parenteral fluid to a patient, an incompressible fluid container, said containers having a common wall therebetween to isolate the fluids in the respective containers, said wall being yieldable to communicate the pressure in the incompressible fluid container to the parenteral fluid container, a supply reservoir containing incompressible fluid therein, a positive displacement pump connected between the supply reservoir and the incompressible fluid container to pump incompressible fluid from the supply reservoir into said incompressible fluid chamber at a predetermined constant flow rate whereby to expel parenteral fluid from the parenteral fluid container at exactly the same flow rate as incompressible fluid is forced by the pump into the incompressible fluid container and independent of the impedance to flow presented by the connection to the patient, and a second pump for supplementing flow of liquid from the positive displacement pump to said incompressible fluid container.

4. Apparatus for the precise administration to a patient of parenteral fluids and the like comprising a parenteral fluid container connected to an infusion tube and needle for connection to and administration of parenteral fluid to a patient, an incompressible fluid container, said containers having a common wall therebetween to isolate the fluids in the respective containers, said wall being yieldable to communicate the pressure in the incompressible fluid container to the parenteral fluid container, a supply reservoir containing incompressible fluid therein, a positive displacement pump connected between the supply reservoir and the incompressible fluid container to pump incompressible fluid from the supply reservoir into said incompressible fluid chamber at a predetermined constant flow rate whereby to expel parenteral fluid from the parenteral fluid container at exactly the same flow rate as incompressible fluid is forced by the pump into the incompressible fluid container and independent of the impedance to flow presented by the connection to the patient, and means to bypass liquid from the incompressible fluid container to the supply reservoir when the pressure in the incompressible fluid container exceeds a predetermined level.

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