This invention relates to apparatus for parenteral administration of liquids and more particularly to a closure cap and drip chamber of containers of liquids which are administered intravenously.

In accordance with modern hospital procedure, it has become common practice to eliminate the resterilization and reuse of apparatus for administering fluids parenterally, in order to avoid the dangers associated with the handling of the apparatus after use and prior to sterilization, as well as to eliminate all possibility of improper cleaning and incomplete sterilization of the apparatus. Accordingly, many types of disposable venoclysis apparatus have been developed with which parenteral solutions can be effectively administered. It frequently has been necessary, however, to combine several distinct pieces of venoclysis apparatus to achieve the desired result. Thus, for example, in administering a solution from a container it has been common practice to use a glass or rigid clear plastic drip meter device associated with a special cap member for the container. Also, where a fluid pumping device is desirable in the system, it would be necessary to insert between the drip meter device and the patient a separate piece of apparatus capable of exerting a pumping action of the fluid in the apparatus system.

It is, therefore, an object of the present invention to provide more economical disposable apparatus for parenteral administration of liquids which can be maintained in a sterile condition ready for immediate use. It is another object of the invention to provide a closure cap for a container of parenteral solutions with a flexible walled drip chamber integrally formed therewith.

It is still another object of the present invention to provide a unitary plastic disposable closure cap and drip chamber.

Other objects of the invention will be apparent from the detailed description and claims to follow, when taken in conjunction with the accompanying drawing.

In the drawings:

Figure 1 is an exploded perspective view of the closure cap and drip chamber of the present invention;

Figure 2 is a vertical sectional view of the integral closure cap and drip chamber shown in Figure 1;

Figure 3 is a top plan view of the closure shown in Figure 2;

Figure 4 is a sectional view along the line 4—4 of Figure 2.

The improved apparatus of the present invention as illustrated in the drawing is employed in association with a container for intravenous liquids as represented by the bottle 1 which is suspended in an inverted position so that its neck projects downwardly from the bottle 1. The neck of the bottle 1 is provided with suitable external screw threads 2. The unitary closure cap and drip chamber 3 which is preferably formed of a flexible resilient plastic material, such as polyethylene plastic, is provided with a screw threaded body section 4 having screw threads 5 on the inner surface thereof, the said screw threads 5 being such as to fit the external screw threads 2 on the neck of the bottle.

The end wall 6 of the closure cap 3 is provided with an enlarged opening 7 having extending downwardly from the periphery thereof an elongated cylindrical wall section 8 forming a drip chamber integral with said end wall 6 together with a reducing section 10 closing the outer end thereof and which has extending axially therefrom a small diameter outlet means 11 adapted to engage the end of a length of flexible tubing 11' which is provided at its outer end with a hypodermic needle or needle adaptor or suitable fluid administering means. The downwardly extending cylindrical section 8 preferably has a wall thickness (preferably approximately 0.020" thick) such that the drip chamber formed thereby is sufficiently transparent to permit observation of the interior thereof but at the same time being sufficiently rigid to retain its original shape and requiring only relatively slight pressure to temporarily collapse, thereby serving as a liquid pump when compressed by the pressure of the fingers of the operator administering the liquid. The longitudinally extending ridges 12 are preferably disposed at diametrically opposite sides of the drip chamber and extend the entire length of the relatively thin wall section 8 from the end wall 6 to the reduced section 10.

The end wall 6 adjacent the enlarged opening 7 is provided with a groove or recessed portion 13 into which is preferably snap-fitted a plug member 14 comprising a main disc portion 15 of such size that the peripheral portion of the disc having a flange 16 adjacent the lower edge thereof resiliently engages the groove 13 in the end wall and is securely held therein.

The plug member 14 is provided with an outwardly projecting cylindrical portion 17 which extends from the lower surface of the disc member and which said plug 14 is disposed in the opening 7 extends into the interior of the drip chamber 9 and serves as a drip former. Plug member 14 also is provided with an oppositely extending cylindrical portion 18 in axial alignment with the outwardly extending portion 17 which serves as the inlet to the drip chamber 9. Since the cylindrical portion 13 extends above the end wall of the closure cap 3, the portion of the cap 3 between the end wall 6 and the upper end of cylindrical portion 18 serves as a sedimentation collector and tends to prevent any large particles in the intravenous liquids entering the drip chamber and passing through the flexible tubing into the body of the patient. The cylindrical portion 18 also serves as a retainer and support for a filter element (not shown) which can be mounted thereon.

The end wall 6 is also provided with an outwardly projecting small diameter tubular section 19, the walls of which are preferably substantially rigid. Intermediate the ends thereof and below the end wall 6 there is provided a conical check ball valve seat 20 terminating in a small diameter portion 21 which serves to divide the tubular section 19 into an upper and a lower chamber. The enlarged lower chamber 22 having inwardly tapered lateral surfaces suitable for receiving an adaptor provided with a Luer taper secured to the end of a length of flexible tubing or the like. A suitable ball check member 23 is disposed in the upper chamber 24 and is maintained therein by a plurality of inwardly projecting lugs 25 extending from the end wall 6 and disposed about the upper edge of the said chamber. The ball member 23 is free to move in the direction of the axis of the tub section 19 so that when the ball rests on the valve seat 20 the passage of liquid downwardly through section 19 from the container is prevented but when the pressure within the container is less than atmospheric pressure as a result of withdrawal of liquid from the container through the drip chamber, air will pass upwardly through the ball
check valve tending to equalize the pressure within the container with the atmospheric pressure.

Disposed on the lower end of the tubular member 19 is a filter cap member 26 having a lower chamber 27 provided with an opening 28 at the outer end thereof. Extending from the upper edge of the chamber 27 is a larger diameter section 29 adapted to removably engage the tubular section 19 without, however, exerting any substantial pressure upon the tubular section 19 as to cause distortion of the ball check valve seat 20. Intermediate the sections 27 and 29 of the cap member there is provided a stop flange 30 which is adapted to engage the lower end wall of the tubular section 19 to prevent the cap member being forced onto the lower end of the tubular member 19 and thereby exerting a distorting pressure on the ball valve seat. The lower section 27 of the cap is adapted to receive a wad of cotton or other filtering material suitable for preventing dust, bacteria, and the like being carried into the parenteral liquids along with the air passing through.

The upper surface of the end wall 6 of the cap 3 is also provided with an upwardly extending circular ridge or sealing ring 31 having a relatively thin diameter section at the upper edge thereof adapted to engage the lip of the bottom neck when the cap 3 is fully seated therein and thereby serve as an integral sealing gasket to prevent the leakage of intravenous liquids.

A dust cap 37, as shown in Figure 1 of the drawing, is adapted to removably engage the upper end of the closure cap and is preferably provided with a tab member 38 to facilitate the removal of the dust cap from the end of the cap. The dust cap member 37 in combination with the filter cap member 26 and the protector cap 39 enclosing the adaptor which is secured to the end of the flexible tubing 11' and which supports a pinch clamp 40, as shown in Figure 1, maintain the apparatus in a sterile condition and prevent contamination with bacteria or dust subsequent to the sterilization of the said closure cap.

In operation, the preferred form of the invention shown in Figure 2 is applied to the neck of the bottle 1 containing the intravenous liquid by removing the dust cap 37 from the upper end of the closure cap 3 and screwing the said closure cap onto the threaded neck of the bottle with the bottle in an upright position so as to facilitate forming a liquid tight seal between the lip of the bottle and the sealing ring 31 on the inner surface of the end wall 7 of the cap. The bottle 1 with closure cap 3 securely disposed on the said neck thereof is then inverted after clamping the flexible tubing by means of a pinching clamp 40, as shown in Figure 1, to prevent the flow of liquid therethrough. While in an inverted position with the closure cap and drip chamber in a downwardly extending position with the pinch clamp 40 closed, the flexible drip chamber 9 is "pumped" by compressing a sufficient number of times to partially fill the said chamber with liquid. The pinch clamp 40 is then opened and a column of liquid flows down the length of flexible tubing displacing the air therein insuring the complete absence of air bubbles from the said flexible tubing and the pinch clamp closed. Thereafter the hypodermic needle which has previously been secured to the end of the flexible tubing is inserted into the patient. The pinch clamp 40 is then gradually opened until the desired rate of flow of intravenous liquid is attained. The rate of flow is readily determined by observing the number of drops of liquid formed per minute at the upper end of the drip chamber as the drops fall through the air space within the partially liquid filled drip chamber, said chamber being sufficiently transparent to permit ready observation of the drops formed within the said chamber. During the administration of the intravenous liquid a partial vacuum is formed within the container by the withdrawal of liquid therefrom and at frequent intervals the ball member 23 will be forced upwardly away from ball check valve seat 20 permitting air to flow upwardly through the cotton air filter into the interior of the intravenous liquid bottle thereby tending to equalize the pressure within the container with the atmospheric pressure. After the liquid within bottle 1 has been completely withdrawn and before all the liquid is emptied from the drip chamber, the flow of liquid is completely interrupted by moving pinch clamp 40 to a sealing position, thereby preventing air entering the patient.

During the administration of the liquid it sometimes happens that an obstruction plugs the inlet end of the cylindrical portion 18. With the structure of the present invention, removal of the obstruction can be performed simply by closing the flexible tubing 11' secured to the discharge outlet of the drip chamber and squeezing the flexible drip chamber with the fingers, thereby creating a back pressure forcing air upwardly through cylindrical portion 18 and dislodging the obstruction in the said opening. Also, where the liquid in the bottle reaches the end portion 18 and becomes partially blocked by solid suspended particles in the liquid, the said filter can be cleared by compressing the walls of the filter drip chamber creating the necessary back pressure.

It is also a frequent occurrence that the liquid level in the drip chamber can be so high that it is impossible to accurately observe the drops formed and determine the rate of flow of intravenous liquid. This condition is commonly referred to as a "flooded" drip chamber. A flooded drip chamber as above described is overcome with the apparatus of the present invention by merely closing the flexible delivery tubing adjacent the drip chamber and inverting the drip chamber and bottle so that the chamber is above the inlet thereto. The liquid in the flooded drip chamber is then readily pumped therethrough into the bottle simply by squeezing the drip chamber, thereby replacing the liquid by air. In this way the drip chamber can be partially or completely emptied of liquid and refilled with air. The drip chamber and the bottle can then be returned to an inverted position with the cap and drip chamber pointing downwardly and the desired liquid level adjusted in the usual manner. Thus, if the liquid level in the drip chamber is lower than desired, air can be pumped out of the drip chamber into the bottle by squeezing the drip chamber while in the latter position.

While the apparatus in its preferred form is molded of polyethylene plastic, it should be understood that the preferred form of the invention can also be molded of other flexible plastic material, such as polyvinyl. It is also possible, however, to mold the closure cap shown in combination with a wide variety of plastic materials including polyethylene, polyvinyl, polysyrene, nylon, and other flexible and rigid plastic materials. The drip chamber in each instance is formed preferably of polyethylene plastic where it is desired to have a flexible resilient drip chamber. If a flexible drip chamber is not desired, however, the chamber 9 can be molded of rigid plastic material, such as polysyrene. Also, the cap body member can be formed of a rigid plastic material, such as nylon, and the drip chamber formed of a flexible plastic, such as polyethylene, and the two sections joined into a unitary structure, as by a solvent, adhesive, or heat seal.

Others may readily adapt the invention for use under various conditions of service, by employing one or more of the novel features disclosed or equivalents thereof. As at present advised with respect to the apparent scope of my invention, I desire to claim the following subject matter.

I claim:

1. Apparatus for the administration of parenteral liquids comprising a plastic closure cap and drip tube means for a container of a parenteral liquid having an end wall and a body section provided with means for detachably connecting the said cap means to the said container
and having an air inlet opening in the said end wall adapted to receive an air valve means, a liquid outlet opening in said end wall adjacent said inlet opening and having a tubular section extending outwardly therefrom, an elongated plastic chamber disposed about the said liquid outlet opening and tubular section, said chamber having flexible resilient walls capable of being readily deformed and returning to the original configuration thereof and having the outer end provided with a reduced diameter section with a small diameter outlet opening securable to a length of flexible tubing for conveying the said parenteral liquid therethrough.

2. Apparatus for the administration of parenteral liquids comprising a plastic closure cap and drip tube means for a container of a parenteral liquid having an end wall and a body section provided with means for detachably connecting the said cap means to the said container and having an air inlet opening in the said end wall adapted to receive an air valve means, a liquid outlet opening in said end wall adjacent said inlet opening having a tubular section extending outwardly therefrom, a relatively thin walled elongated plastic chamber disposed about the said liquid outlet opening and tubular section, said chamber having flexible resilient walls formed integrally with the said end wall and capable of being readily deformed and returning to the original configuration thereof and having the outer end thereof provided with a reduced diameter section with a small diameter outlet opening securable to a length of flexible tubing for conveying the said parenteral liquid therethrough.

3. Apparatus for the administration of parenteral liquids comprising a plastic closure cap and drip tube means for a container of a parenteral liquid having an end wall and a body section provided with means for detachably connecting the said cap means to the said container and having an air inlet opening in said end wall adapted to receive an air valve means, a relatively large diameter outlet opening in said end wall adjacent the said inlet opening, a plug member with a relatively small diameter axial passage therethrough adapted to be retained in said outlet opening and provided with a tubular section extending outwardly from said end wall, an elongated plastic chamber disposed about said tubular section coaxially therewith extending outwardly from the said end wall and being integral therewith, said chamber having flexible resilient walls formed integrally with the said end wall and capable of being readily deformed and returning to the original configuration thereof and having the outer end thereof provided with a reduced diameter section with a small diameter outlet opening adapted to be secured to a length of flexible tubing for conveying the said parenteral liquid therethrough.

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