CONTROL DEVICE FOR PARENTERAL LIQUID FEED APPARATUS

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References Cited

UNITED STATES PATENTS
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1,982,062 11/1934 Matthews 137/104
2,668,533 2/1954 Evans 128/214 C
2,807,012 9/1957 Schwarz 128/214 E
3,469,574 9/1969 Durkan 128/214 E
2,933,294 2/1960 Reimann et al. 128/214 R

3,227,173 1/1966 Bernstein 128/214 C

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ABSTRACT

A fluid flow control device for an administration set used to introduce parenteral liquids into a patient. The control device has a body releasably attached to a container storing the liquid and connected to a feeding tube for carrying the liquid to a hypodermic needle. A cone-shaped valve connected to a float controls the rate of flow of liquid through a passageway in the body. The valve and float are movably mounted on the body. When the level of liquid in the container is lowered to or reaches a point where the container is substantially empty, an amount of liquid is retained in the container so that limited flow of liquid through the passageway is continued for a period of time.

10 Claims, 4 Drawing Figures
CONTROL DEVICE FOR PARENTERAL LIQUID FEED APPARATUS

BACKGROUND OF INVENTION

Intravenous liquids are administered by gravity feed from an elevated and inverted container storing the liquid. The liquid is delivered from the container into a vein of a patient through a feed tube coupled to a hypodermic needle. Check valve devices have been developed to stop administration of the parenteral liquid when the liquid is nearly exhausted. These units are designed to abruptly stop the flow of fluid to prevent the danger of air or other gases being passed from the unit to the patient. Martinez discloses in U. S. Pat. No. 2,784,733 a float-type check valve operative to stop the flow of fluid in an administration set. A similar type valve is disclosed by Bernstein in U. S. Pat. No. 3,227,173. Other types of valves, as flexible diaphragms have been employed to close off or seal the outlet opening of an apparatus for administering a parenteral solution. An example of this diaphragm-type valve is shown in U. S. Pat. No. 3,216,419. When the valve structures in all of these intravenous devices are closed, the fluid flow is terminated.

SUMMARY OF INVENTION

The invention is directed to a fluid flow control device for an administration set for parenteral liquids. The device is capable of reducing the rate of flow of liquid in conjunction with the level of liquid in the container attached to the administration set. The control device has a body in the form of a cap that is attached to the outlet portion of the container. The body has an outlet passageway for directing a liquid to a collector member connected to a tube carrying the hypodermic needle. Liquid control means is movably mounted on the body for controlling the rate of flow of liquid through the passageway when the level of liquid in the container approaches the body. The control means has a movable valve that is insertable into the passageway which restricts the flow of liquid through the passageway at a reduced rate. For example, the flow rate can be reduced to four or five drops per minute. This flow rate allows the intravenous opening in the hypodermic needle to remain open for a period of time. This period of time is sufficient for the attendants to change the container before the liquid runs out. The position of the valve is controlled with a float located in the bottom portion of the container. The body has a support slidably supporting a connecting rod secured to the float and the valve.

An object of the invention is to provide a parenteral liquid feed control device that will automatically reduce the flow rate of intravenous liquid flowing through the tube connected to the hypodermic needle when the level of liquid in the container approaches the bottom of the container. A further object of the invention is to provide a liquid feed control device that is a one-piece assembled unit which is attachable to the conventional container storing the liquid.

IN THE DRAWING

FIG. 1 is an elevational view of an intravenous liquid feeding apparatus having the liquid feed control device of the invention;

FIG. 2 is an enlarged elevational sectional view of the liquid control device mounted in assembled relation with a liquid storing container;

FIG. 3 is a sectional view taken along the line 3–3 of FIG. 2; and

FIG. 4 is an enlarged sectional view of the liquid feed control valve of FIG. 2.

Referring to the drawing, there is shown in FIG. 1 a parenteral or intravenous liquid feeding apparatus, indicated generally at 10, in position for gravity feed of the liquid to a patient. The apparatus 10 is secured to the neck or open end of a bottle or container 11 storing the intravenous fluid 12 being administered to the patient. The lower end of the apparatus includes an elongated, flexible feed tube 13 of rubber, plastic, or the like. The feed tube 13 is connected to a hollow hypodermic needle 14. The needle 14 has its forward portion inserted into the arm 16 of the patient. A pinch valve 17, or similar control valve, carried by the tube 13, controls the flow rate of liquid through the tube. The pinch valve 17 may be replaced by flow meters measuring the rate of intravenous infusion of the parenteral liquid. Examples of suitable flow meters are shown in U. S. Pat. Nos. 3,348,543 and 3,587,313.

In use, the container 11 is replaced when the supply of fluid in the container 11 has been exhausted. Prior to the present invention, the gravity-type intravenous administrators were provided with check valves which terminated the infusion to eliminate admission of air into the feed tube. When the flow of intravenous fluid is terminated, the needle becomes clogged. A new needle is needed to continue the feeding of subsequent amounts of liquid. Replacing the container and needle requires additional time and subjects the patient to additional pain.

As shown in FIG. 2, the container 11 has an open neck or end 18 having external threads. The neck 18 surrounds the outlet passageway 19 of the container 11. The liquid feeding apparatus 10 has a generally cup-shaped body, indicated at 21, that is releasably mounted on the open end of the container 11. The body 21 has an annular flange 22 provided with internal threads that cooperate with the external threads on the neck 18 so that the body is threaded onto the end of the container. A generally flat wall 23, integral with flange 22, closes the container passageway 19. The wall 23 has an outwardly directed boss or projection 24 having an opening carrying a hollow cylindrical member or tube 26. The tube 26 has a longitudinal outlet passage 27 for carrying liquid from the container through body 21.

An elongated, cylindrical member 28 having a chamber 29 for collecting the fluid discharged through the passageway 27 is attached to the boss 24. The member 28 is transparent material, as glass or plastic, and has a cylindrical upper end that is located in a tight sealed relationship with the external face, or surface, of the boss 24. The bottom of the member 28 has an outwardly directed nipple 30 having an outlet passageway 31. The feed tube 13 is mounted on the nipple 30 so that the liquid flows from chamber 29 through the passage 31 into the feed tube 13.

The rate of flow of liquid 12 from the container 11 into the cylindrical member 28 is controlled with a fluid control means indicated generally at 32. Control means 32 has a valve 33 connected to a float 34 or similar buoyant member with a linear rod 36. The valve 33 has
a generally cone shape with a smooth, downwardly and inwardly tapered circular outer surface 37. The lower end 38A of the valve 33 has a generally flat circular shape and a diameter approximately one-half the diameter of the upper end 38B of the valve 33. The longitudinal length of the valve 33 is approximately twice the diameter of the upper end 38B. The inside diameter 39 of the tube 26 is slightly larger than the diameter of the upper end 38B of the valve 33.

As shown in FIG. 4, as the valve 33 moves into the passageway 27, there is a continuous annular space 40 between the outer surface 37 of the valve and the inside wall of the tube 26. This space 40 permits restricted flow of fluid through the passageway 27 during the closing of the valve 33. As shown in FIG. 2, as the fluid level in container 11 approaches the body 21, the float 34 lowers the valve 33 into the passageway 27. This restricts the flow of fluid through the passageway 27. The annular space 40, being relatively small, permits the continued flow of liquid at a reduced rate of, for example, approximately four or five drops per minute. Other flow rates can be used to achieve limited flow through needle 14. This allows the intravenous opening in the hypodermic needle to remain open for approximately 30-45 minutes. This time interval provides nurses or other personnel sufficient time to change the container 11 before all the fluid is dispensed. The advantages of this type of operation are that it saves considerable time in administration of intravenous fluids and eliminates the necessity of changing needles.

The valve 33 is aligned with passageway 27 with a support 41 having a laterally directed portion or extension 42 spaced from and extended over the passageway 27. The extension 42 has a longitudinal hole 43 for slidably receiving the rod 36. This support 41 is secured to the inside face or surface of the wall 23 of the body 21. The body 21, support 41 and extension 42 can be a one-piece member of metal, plastic, or similar material. The valve 33 is located on the lower side of extension 42. The float 34 is located on the upper side of extension 42 and extends into the lower portion of the container 11. As shown in broken lines, when the level of liquid in the container is high, the float 34 holds the valve 33 in engagement with the lower side of the extension 42. When the valve 33 is in this position, the passageway 27 is entirely open, permitting the free flow of fluid from the container 11 through the passageway 27 and into the chamber of the cylindrical member 28.

The body 21 carries an air check valve assembly indicated generally at 44. Check valve assembly 44 has a cylindrical member 46 that is threaded into a suitable hole in the wall 23. The member 46 has a passageway 47 leading to a chamber 48 open to the inside of the body 21. A check valve in the form of a ball 49 is located in the chamber 48. A pin 51, or similar retaining structure, is used to hold the ball 49 in floating assembly relation with the member 46. The ball 49 blocks the opening to the passageway 47 so that the liquid 12 does not flow through the check valve. Reduced pressure in the container 11, caused by lowering the level of liquid in the container, will cause air to move into passageway 47 to displace the ball, thereby allowing air into the container. Other types of one-way check valve assemblies can be used to permit air to replace the dispensed fluid in container 11.

In operation, with the container 11 in an inverted gravity feed position, as shown in FIGS. 1 and 2, the liquid 12 will exert lifting or buoyant forces on the float 34, thereby holding the valve 33 in engagement with the extension 42 and keeping the passageway 27 open. The liquid 12 flows through the passageway 27 into the chamber 29. The feed line 13 delivers the liquid to the hypodermic needle 14 which discharges the solution to the vein of the patient. As the level of the liquid in the container 11 approaches the neck of the container, the flow control apparatus 10 functions to reduce the flow rate of liquid dispensed from the container. The float 34 moves down with the level of liquid, thereby moving the valve 33 downwardly into the passageway 27. The shaft 36, being linearly guided in the hole 43, directs the valve into the upper end of the tube 26. The valve 33, having a continuous cone-shaped surface, restricts the rate of flow of liquid through passageway 27. The valve 33, being smaller than the passageway 27, does not at anytime stop or block the flow of liquid. The flow is reduced so that it continues at a rate of, for example, approximately four or five drops per minute. Other reduced flow rates can be used to maintain limited feeding of liquid to the needle 14. This will continuously supply liquid to the feeding tube so that the hypodermic needle will remain open. The slow rate of feed will insure that no air or other gases are allowed to enter the feed line 13. Also, the reduced flow rate of liquid provides the attending personnel sufficient time to remove the control device from the substantially empty container and place it on a full container so that the feeding of the fluid to the patient can be continued without the necessity of replacing the needle.

The invention has been described with respect to the preferred embodiment. It is understood that various changes in size and material are within the purview of the invention as defined in the appended claims.

The embodiments of the invention in which an exclusive property or privilege are claimed are defined as follows:

1. A parenteral liquid feed control device connectable to a container for storing parenteral liquid and a tube means to deliver the liquid to a needle comprising: body means mountable on the container to receive parenteral liquid, said body means having an outlet passageway for said liquid; means connected to the body means and adapted to be connected to the tube means to carry said liquid from the outlet passageway of the body means to the tube means; and liquid control means movably mounted on said body means for controlling the rate of flow of liquid through the passageway, said control means having a valve member movable toward the passageway to allow limited flow of liquid through said passageway when the level of the liquid in the container reaches a point whereby an amount of liquid is retained in the container so that the limited flow of liquid through said passageway is continued for a period of time, said valve member being of a size smaller than said passageway whereby a limited amount of fluid continues to flow through the passageway when the valve member is located in said passageway.

2. The liquid feed control device of claim 1 wherein said body means includes a cup-shaped member releasably attachable to the container.

3. The liquid feed control device of claim 1 wherein said means connecting the body means to the tube means comprises an elongated cylindrical member having a chamber for accumulating liquid.
4. The liquid feed control device of claim 3 wherein:
said body means has an outwardly directed boss, said
elongated hollow cylindrical member having an end
mounted on said boss.

5. The liquid feed control device of claim 1 wherein:
said liquid control means includes a float positionable
in said container when the body means is attached to
the container, and means movably mounted on the
body means connecting the float to the valve member.

6. The liquid feed control device of claim 1 wherein:
said valve member has a cone-shaped outer surface
that is smaller than said passageway, whereby fluid con-
tinues to flow through said passageway when the valve
member is located in the passageway.

7. The liquid feed control device of claim 1 wherein:
said body means has a support member projected to-
ward the container, said support member having a por-
tion spaced from and extended over said passageway,
said liquid control means including a float located adja-
cent the container side of the portion of the support,
said valve being located adjacent the opposite side of
said support, linear rod means slideably positioned in
a hole in said portion of the support connected to the
float and the valve member to linearly align the valve
member with the passageway.

8. The liquid feed control device of claim 7 wherein:
said valve member has a downwardly converging cone-
shaped outer surface and a transverse cross sectional
area smaller than the transverse cross sectional area of
the passageway whereby fluid continues to flow
through said passageway when the valve member is lo-
cated in the passageway.

9. The liquid feed control device of claim 7 wherein:
said body means has an outwardly directed boss, said
means connecting the body means to the tube means
comprising an elongated hollow cylindrical member
having an end mounted on said boss.

10. The liquid feed control device of claim 7 includ-
ing: an air check valve assembly mounted on said body
means operable to permit air to flow into the container
to replace the liquid drained from the container.

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