Nov. 16, 1948. F. T. ROBERTS 2,453,814

PEDIATRIC SYRINGE

Filed July 12, 1947

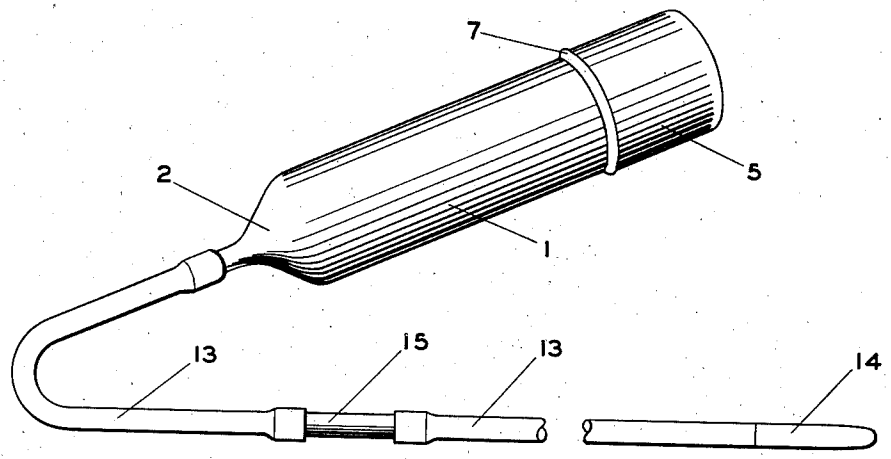


FIG. 1

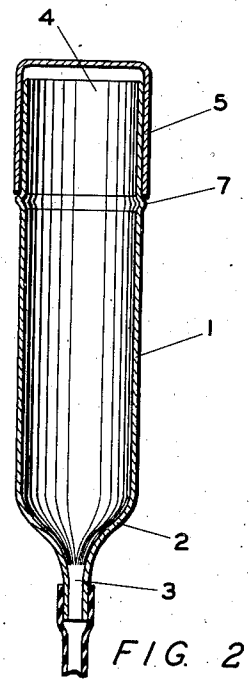


FIG. 2

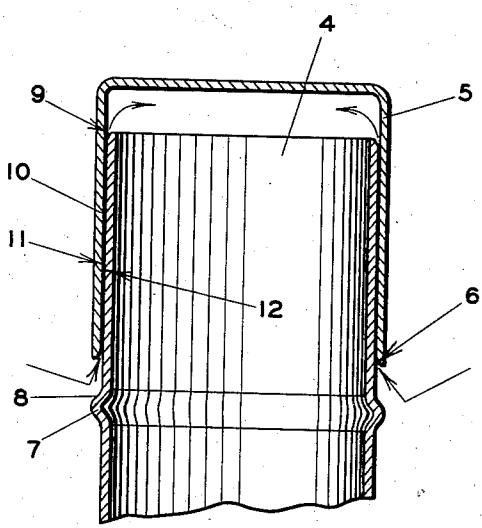


FIG. 3

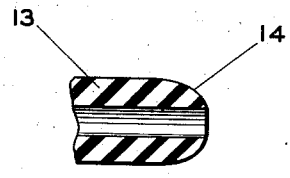


FIG. 4

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PEDIATRIC SYRINGE

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1 Claim. (Cl. 128—227)

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This invention relates to syringes and more particularly to pediatric syringes for rectal administration of fluids.

Those acquainted with the design and use of rectal syringes, especially those for pediatric use, have long recognized the need for a syringe having a gravity flow so designed that the same person could both insert the delivery tube in the rectum and concurrently control the velocity of delivery within fine limits. This has been partially accomplished by a few designs, especially those utilizing a rigid delivery tube in combination with a collapsible reservoir. This solution is not satisfactory, however, because when the patient is lying on his back, the normal position for rectal administration of fluids, the rectum from the anus to a point just distal to the sphincter ani is directed anteriorly where it makes a sharp turn and is directed posteriorly and thereafter generally follows the spinal curvature. It is desirable that the end of the delivery tube be passed just beyond the internal sphincter ani but the reversal of the rectal tract at this point necessitates the insertion of a syringe having a rigid delivery tube in such a manner that the bulb of the syringe is below the delivery point making it impossible to use a gravity flow. To overcome this, some type of pressure injection is used. The use of pressure to move the fluid is dangerous except in the hands of a very skilled operator and even then there is likely to be a very noticeable fluctuation in the pressure and rate of delivery. In addition to this the position of the reservoir below the end of the delivery conduit forces any air in the syringe to be delivered to the patient at the start of the operation resulting in unnecessary discomfort.

It is necessary, especially in pediatric cases, for the operator to use two hands to make the initial insertion of the tube. The presently available gravity flow syringe equipment requires the operator to hold the syringe reservoir to prevent leakage or spilling of the liquid, thus, necessitating the assistance of another person. Even after the initial insertion has been made this equipment requires two operating personnel. One person is required to hold the reservoir and regulate the rate of flow while the other person is required to administer the delivery tube. Furthermore, this equipment lacks means whereby the rate of flow may be regulated with any degree of accuracy. The present methods of control are only effective within broad limits.

My invention eliminates these disadvantages by providing a device in which the reservoir is so constructed that it may be laid down by the operator without any resulting leakage or spilling, leaving both hands free to administer the initial insertion. After the initial insertion my syringe may be supported for gravity flow of the fluid and the velocity of flow closely regulated by a single hand leaving the operator's other hand free to administer the delivery tube.

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It is, therefore, a primary object of my invention to provide a syringe having a fluid reservoir and a means for controlling the velocity of flow of the fluid which may both be held and manipulated with one hand.

Another object of my invention is to provide a syringe having a reservoir which may be laid onto a table in non-delivering position without leakage.

Another object of my invention is to provide a syringe capable of delivering fluid by gravity.

A further object of my invention is to provide a syringe in which the rate of flow may be easily and closely controlled.

Another object of my invention is to provide a syringe capable of a slow delivery rate.

An additional object of my invention is to provide a syringe which will not contain any air in the delivery tube prior to administration.

Another object of my invention is to provide a syringe which will retain the initial temperature of the contents for a longer period of time.

A further object of my invention is to provide a syringe having a delivery tube capable of bending to conform with the shape of the rectal tract.

A further object of my invention is to provide a syringe which may easily be maintained in a sanitary condition.

Other objects and advantages of my invention will become apparent from a reading of the following description taken in connection with the accompanying drawings, in which:

Figure 1 is an oblique view of my syringe with the delivery tube attached.

Figure 2 is a sectional view of my syringe taken along the longitudinal centerline.

Figure 3 is an enlarged fragmentary sectional view of my syringe showing the cap in a partially removed position.

Figure 4 is an enlarged fragmentary, central-sectional view of the end of the conduit of my syringe.

In providing a device meeting the objects and purposes outlined above, I have provided a structure which includes a cylindrical reservoir having a flexible delivery tube at one end and a closure cap at the other. Clearance is provided between

the reservoir and the closure cap, which clearance is so limited as to effect a control over the rate of flow of the fluid from the reservoir by selectably impeding the quantity of air entering to displace the fluid. The flexible tube permits the reservoir to be held in any desired position irrespective of the required direction of the delivery tube.

Description

Referring now to the drawings in more detail, the numeral 1 indicates a syringe body of cylindrical construction having an end 2 tapering in the form of a modified cone to a restricted opening 3 (Fig. 2). This taper is preferably accomplished by forming the end of the body 1 through a smooth reverse curve to eliminate any sharp corners or pockets. The other end 4 of the syringe body is open. The walls of the syringe body are externally chamfered 9 at the open end to facilitate the installation of the cap 5, hereinafter described.

A cup-shaped closure cap 5 fits over the open end 4 of the syringe body and has an internal diameter slightly larger than the external diameter of the syringe body to permit the syringe body to fit slidingly within the cap. The internal wall of the cap at the open end is provided with a chamfer 6 (Fig. 3).

A circumferential collar, or bead, 7 surrounds the syringe body 1 and is sufficiently spaced from the open end 4 that the end of the cap 5 will engage it when the cap is in a closed position as shown in Fig. 2. This collar acts as a stop for said cap to limit its movement in the telescoping direction, but does not establish an airtight relationship therewith. The walls 8 of this collar 7 engaging the cap 5 is at an angle of less than 90 degrees, preferably between 45 degrees and 60 degrees, with the walls of the syringe. By thus eliminating a sharp corner between the collar and the main body of the syringe, cleaning of the instrument is facilitated. The collar may be made integral with the syringe body walls by deforming the walls outwardly as shown in the drawings or it may be a separate piece rigidly attached to these walls in any suitable manner.

The air passage 10 between the inner surface 11 of the cap 5 and the outer surface 12 of the syringe body 1 must be held to a maximum of approximately .0015 inch, i. e. the total differential between the diameter of the inner surface 11 of the cap and the diameter of the outer surface 12 of the syringe body should be not greater than about .003 inch. This differential should not be less than about .001 inch giving the air passage 10 a minimum width of .0005 inch. This spacing must be held within these limits the full distance for which the cap 5 encloses the syringe body 1. The purpose of this spacing will be explained more fully hereafter.

Both the body 1 and the cap 5 are made from metal which will not react with any of the substances used in a rectal syringe and capable of being given a smooth, shiny surface, such as aluminum, stainless steel, or chrome or nickel plated steel. The requirement of having a shiny surface is important since this factor determines the capacity of the syringe to retain the heat of the fluid within it. By utilizing the long wave radiation inhibiting properties of a shiny surface the thermal efficiency of the syringe is increased such that it has a heat retaining characteristic superior to similar instruments not having a shiny surface even though made from materials normally constituting better heat insulators, such as glass.

The syringe body and cap may, when formed of aluminum, be made to sufficiently close tolerances by spinning, impact extrusion, or stamping which operations also provide a product having the desirable smooth contour. While this normally gives sufficiently close dimensional control, still closer tolerance control of the air passage dimensions may be obtained if desired by chrome plating a suitable base material such as thin steel by conventional procedures. The thickness of the chrome deposit is capable of minute regulation according to presently known practice and thus, where an extremely high grade product is desired, very exacting requirements may be met. This procedure also produces a more durable article as the resulting surfaces are highly wear-resistant.

Where chrome plating is not used the metal surface may be anodized or otherwise treated to produce a stable, non-reactive surface.

I have conducted experiments to determine the heat retaining efficiency of a metallic syringe having a reflecting surface and that of a glass syringe. In one each experiment, an aluminum syringe having a shiny, highly polished surface was employed, together with an ordinary glass syringe of the same dimensions. The two syringes were immersed in water at 100 degrees F. for a few minutes, removed and filled with 2 ounces of water at 100 degrees F. The exteriors were then dried and the syringes closed by a cardboard cap with a thermometer suspended in each and placed in a room at 72 degrees F. The water was not agitated during the experiment. The resulting readings taken at successive minutes were:

Aluminum Syringe, Water Temperature, °F.	Elapsed Time	Glass Syringe, Water Temperature, °F.
100	0	100
100	1	99
99	2	98
98	3	97
97.8	4	96.5
97.5	5	96
97	6	95.8
96.5	7	95
96.2	8	94.2
96	9	94
96	10	94

In another experiment in which the ends were left uncapped similar results were obtained.

Temperature readings after 10 minutes at the restricted end of the syringes, corresponding to area 2 in the drawings, showed the temperature to be 96 degrees F. in the metallic syringe and 89 degrees F. in the glass syringe.

The conduit 13 is made from any material having soft, flexible characteristics, preferably soft rubber. The walls at the end 14 are tapered to reduce irritation and facilitate insertion. The conduit 13 may be cut at a suitable point and a length of clear tubing 15, as glass or methyl methacrylate ("Lucite"), inserted as shown in Fig. 1. A colored band 17 is provided around the tube a suitable distance from the end 14 to indicate the proper depth of insertion. Such a band may either be permanently painted on, such as by using silver nitrate on a rubber tube, or cast into the tube itself.

Assembly and operation

To assemble the syringe the conduits 13 are passed over the transparent tube 15 and the end 2 of the body 1.

To operate the syringe the first step is to heat the syringe to the temperature of the fluid to be placed in it. This may be done by immersing the instrument in water of the desired temperature. The syringe is then held in an upright position with the conduit end 14 above the body end 4 and the body 1 filled with liquid. The cap 5 is then placed on the body 1 and passed down the body until it contacts the collar 7. The chamfers 6 and 9 facilitate this operation by guiding the two parts into the proper relationship. As the cap is put on it should be given a rapid movement at first to expel any air remaining in the conduit 13 but as soon as liquid appears at the conduit end 14 the movement should be slow enough to allow the air trapped in the cap to escape.

When the syringe is filled, and ready for use, with the cap 5 against the collar 7 the operator may lay it down while the initial administration of the conduit is made. With the very small fluid head thus existing, the long, restricted air passage 10 prevents air entering the fluid chamber and thus, no leakage results.

After the conduit has been administered to the patient, the body of the syringe or reservoir is held at a sufficient height above the conduit end 14 to effect gravity flow of the fluid therefrom.

As the syringe is raised and the fluid head urging flow thereby increased, a slight flow out of the discharge tube will occur even with the cap in closed position. As the cap is raised with respect to the syringe body, the air passage 10 is shortened, the frictional resistance to air flow thereby decreased and air flow thereby increased, and fluid flow will increase, proportionately. Thus by varying the height of the reservoir above the patient and by varying the position of the cap on the syringe body, a very sensitive and exacting control over the rate of fluid discharge can be effected.

This control is effected by restricting the air passage 10 to a point where the friction resulting from air contacting the walls 11 and 12 as it enters the reservoir is capable of affecting the entire air stream to materially impede the rate of air flow. Since the effect of such frictional resistance to the air flow is accumulative the length of this air passage governs the ultimate rate of flow. Thus, as the air passage 10 is shortened, the frictional factor is correspondingly reduced and the rate of flow permitted to accelerate. By reason of the atmospheric pressure bearing against the liquid at the conduit end 14 the liquid can only flow out as fast as it is replaced by air in the reservoir. A simple and sensitive flow rate control is thereby established.

By making the restricted air passage 10 within the range of the dimensions above given, said passage is of such area that when the cap 5 is in the fully closed position a liquid having the viscosity of water at room temperature will not

pass through it when under the low head existing when the syringe body is lying horizontally. This enables the operator to place the syringe horizontally on a table without leakage of the contents, and yet when it is raised for operation air will pass therethrough and permit outflow of the liquid within the reservoir under full control as above specified.

The flexible rubber tube permits the reservoir to be held in a vertical position above the patient despite the fact that the rectal tract proceeds in a different direction. It also permits the end 14 of the conduit to pass the bend in the rectal tract at the sphincter ani without causing irritation or damage to the mucous membrane at this point.

The clear portion of the tube enables the operator to determine when the reservoir is empty as well as the rate of flow during the operation.

Various modifications in the specific structure herein described will suggest themselves to those skilled in the art, but it is to be understood that the invention hereby disclosed is to be limited only by the spirit and scope of the appended claim.

I claim:

A pediatric syringe comprising: a tubular member open at one end and having a restricted opening at the other end; a cup-shaped closure member telescoping said tubular member at said open end for removably closing said open end, said closure member having an internal diameter from about 0.001 inch to about 0.003 inch greater than the external diameter of said tubular member; whereby the rate of air flow between the inner surface of the closure member and the external surface of the tubular member may be accurately regulated by varying the extent of telescoping of the tubular member by the closure member, and when the tubular member is in a position such that the open end of said tubular member is above the restricted end thereof the flow of liquid within the tubular member out of the restricted opening may be closely and accurately regulated by axial movement of said closure member on said tubular member.

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