Nov. 26, 1940. V. LOUGHEED 2,223,179

NURSING NIPPLE

Filed Aug. 14, 1937

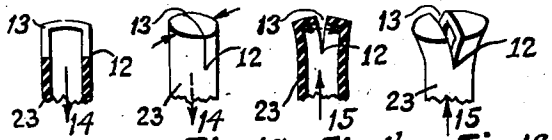

Fig.1. Fig.1a Fig.1b Fig.1c

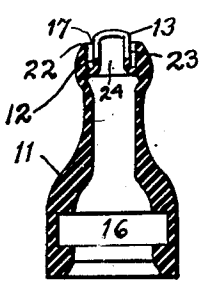

Fig.2.

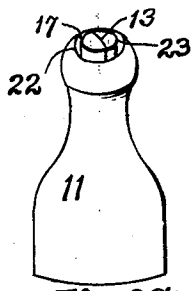

Fig.2a

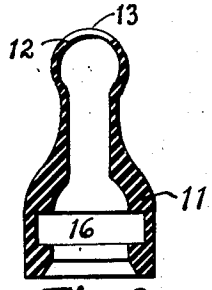

Fig.3.

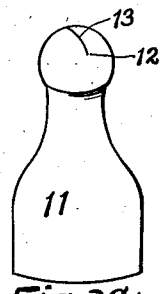

Fig.3a

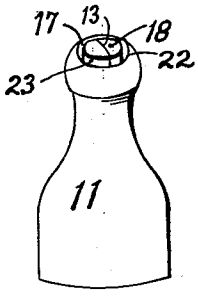

Fig.4.

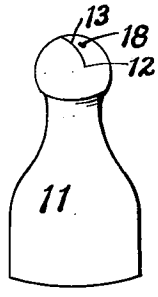

Fig.4a

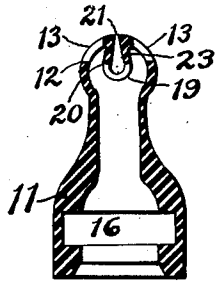

Fig.5.

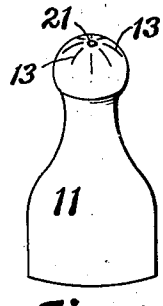

Fig.5a

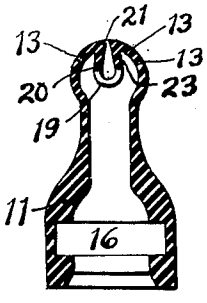

Fig.6.

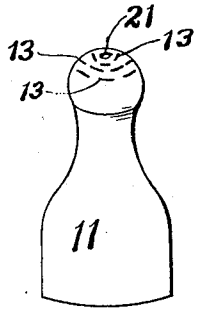

Fig.6a

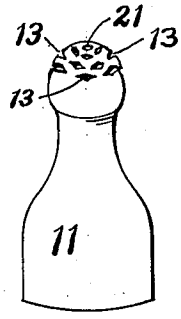

Fig.6b

Inventor

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2,223,179

NURSING NIPPLE

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Application August 14, 1937, Serial No. 159,190

1 Claim. (Cl. 128—252)

My invention relates to rubber or similar nursing nipples, designed for the artificial feeding of infants with rapidity comparable to that of normal breast feeding, under normal suckling pressures.

All artificial nipples of the prior art, and at present purchaseable on the market, have the defect that they only permit abnormally-slow feeding therethrough—or, if they be modified to eliminate this fault, the equally-objectionable defect of pouring the liquid food into the child's mouth during the moments when suckling is intermitted, with the result of causing choking, gagging, and regurgitation.

Accordingly, the especial object of my invention is to embody in new and useful structures the findings of an exhaustive and the first research that ever has been made in the way of measuring the suction that babies' mouths can exert, and the actual rates of flow at these suction values from the breast of a normal nursing mother.

In more detail, the objects of my invention are to provide a free release of liquid food into a child's mouth only during the moments when it is actually suckling, then as rapid and adequate as the flow from the mother's breast under the same degree of vacuum, while at intervals between suckling, while the little mouth is resting, to shut the flow completely off, positively and automatically—again similarly to the action of the mother's breast.

Another important object of my invention is to avoid colic due to the swallowing of air, by minimising or preventing the passage of such air into the mouth from between the nipple teat and the lips. Careful tests have proved such leakage to be the chief cause of swallowed air, and that air intake by this route is not preventable by any form or surface qualities that can be given a nipple. For it is mainly due to nothing else but abnormally-prolonged and persistent suckling upon nipples with food orifices so small that the partial vacuum within the mouth cannot be appreciably or quickly relieved by an inflow of food, the continued fight to secure which thus draws air in around the nipple teat, which the lips gradually tire of clasping tightly.

Still another object of my invention is prevention of nipple collapse, and avoidance of the one occasion for strain during suckling, other than that due to lack of free outflow openings in the nipple. This strain is due to the gradual building up in the bottle of a partial vacuum, or "back pressure", as its liquid contents are abstracted, until it finally becomes necessary to let air in to get liquid out. Necessity for thus frequently relieving the partial vacuum I meet in preferred embodiments of my invention by allowing air displaced in the child's mouth by the entrance therein of liquid, to be passed, a bubble for each swallow, into the bottle. By this functional procedure, allowed by the means I provide, there is ended all tendency for the liquid food to force air from the mouth down into the stomach with it. Obviously, with passages that are valvular, and normally-closed, their functioning can be made unidirectional, whereas with passages that are capillary, and normally—open, as in nipples of existing practise, such openings allow flow, even though too-constricted, to take place in either direction. Hence it is a feature of the valvular passages provided for outflow in my structure that they allow outflow only. Wherefore it is a desirable and important combination to provide other valvular passages for inflow, the functions being differentiated in that the outflow valves pass liquid out, while the inflow valves pass air in.

Incidental objects, found advantageous in rendering artificial feeding as expeditious as natural feeding are: that each food ration, offered at a proper temperature, is consumed before it appreciably cools, thus avoiding injury to health which can result from chilling the child's throat and stomach, while also avoiding the need and bother of reheating; that the unnatural strain of unnaturally-slow feeding, which severely tires a small or delicate infant and often causes even a lusty youngster to refuse to take his full portion, is abolished; that the similar strain on mother or nurse is correspondingly-eased; that mouth malformation, consequent upon undue suckling effort and too-long suckling time, are eliminated along with under nutrition; and that the feeding is effected through extremely-multiple openings, as in the human breast, instead of through only one or a few openings, as in conventional artificial nipples.

How markedly important all these factors are may be judged from the fact that artificial nursing with nipples of the prior art may consume as much as half or three-quarters of an hour for each feeding, for as little as three and one-half ounces at a feeding, whereas with breast feeding, or with nipples of my invention, it can be demonstrated that complete satiation of a hungry child can be accomplished in as few as four or five minutes, or at the rate of an ounce or even more per minute—though there is nothing about either breast feeding or the nipple in any proper embodiment of my invention to compel a child to

take his food this rapidly, or fast enough to do him harm. It is wholly a matter of it being important to his health and welfare to allow him to take his milk as fast as he wants it, or as slowly as he may want it, in place of constraining him to do abnormally-hard suckling for an abnormally-slow food intake.

Essential incidental objects also sought to be embodied in the structure of my invention are: ease and economy of manufacture, without departure from the highest standards of quality, so as to provide its merits at low cost for all artificially-fed babies; simple and clean-lined design, readily allowing complete and expeditious sterilization by established procedures of washing, steaming, or boiling; provision of all necessary elements of the necessary combinations in a one-piece integral structure wholly of rubber or the like, so that there is nothing to take apart or assemble, and nothing that could come loose in a child's mouth; provision of any conventional, standard, or desired teat form, in combination with any bodies or bases required to be readily-applicable to standard or other bottle necks; and attainment of the outflow control which distinguishes my invention, directly at the teat tip or orifice end, so that there can be no accumulation of air between valve and outflow opening, which would have to be sucked out ahead of each ingestion of liquid—if the valve and outflow opening were not one and the same.

Studies made for the first time in connection with this invention—insofar as there is any published or other evidence to the contrary that can be found—have determined that the maximum suction that a baby's mouth can exert is approximately 1.20 pounds to the square inch, and it has been found that this suction maintained at the mother's breast will draw therefrom an average of at least one ounce of milk a minute. The maximum hydrostatic head that can be established in standard eight-ounce nursing bottles, completely filled with the heaviest formula used for baby feeding and vertically-inverted, is about .3 pound to the square inch—barely more than one-fifth of the pressure which can be developed within a nipple by an infant's feeding effort.

With nipples of the present art, as commonly sold, the one or three tiny capillary holes with which they are commonly pierced will pass only a small fraction of an ounce per minute, under subjection to the maximum mouth suction of 1.2 pounds, and still less with weaker suction. Yet with any adequate provision made, as by an air-inlet valve in the side of the nipple, to allow air to replace liquid taken out, such a nipple, on an inverted bottle, will drip continuously until the bottle is emptied. It is common practise, in the use of present nipples, for mothers and nurses to enlarge the capillary openings with a heated pin or needle. By this highly-unscientific and random procedure, such nipples as are not wholly spoiled thereby can be, of course, opened up to allow any freedom or rapidity of outflow that may be desired. But the fault of this procedure is that such outflow then occurs in a steady stream and quite ceases to be under control of the baby's mouth suction, as is the similarly-adequate flow from the mother's breast, and therefore can be controlled only by the nurse taking the nipple out of the mouth at intervals determined by guessing at the baby's need or desire, and tilting the bottle back into an upright position. There is thus established a tendency to force ahead of each swallow of milk a swallow of air, the nipple is unnecessarily exposed and re-exposed to contamination, and the feeding apparatus as a whole becomes no more than a mere pouring device, little better than a pitcher or a spoon, for filling the little mouth, and certainly becomes, in both its physical and psychological characteristics, a very poor simulation indeed of the feeding process prescribed by nature.

The solution my invention provides for the problem thus explained and defined consists in incorporating within artificial nipple structures, combinations of valvular orifices, or of valvular and non-valvular orifices, of such characteristics that the valving of the outflow orifices is directly within the nipple teat, within the child's mouth, so that there can be no trapped air to be sucked out ahead of the liquid food; and that the nature of the valving is such that the orifices are normally closed, and will so remain closed, regardless of normal lip pressure, against any pressure up to and moderately exceeding the hydrostatic head of, say, .3 pound, established by the weight of the bottle contents, and yet will freely and widely gape open, apart from any question of the degree of lip pressure, solely by internal pressure within the nipple established by the act of suckling, and well below the maximum of 1.2 pounds to the square inch that can be thus established. Also in the structure of my invention, in addition to the one or more outflow valves in the teat portion of the nipple, within the mouth, I provide orifices or passages for air inflow, also preferably valvular, and within the mouth—though in what I regard as inferior embodiments of my invention these air-inflow openings may be capillary, or not in the mouth, either or both of these.

My invention is illustrated in the accompanying drawing, of which: Figure 1 shows by sectional and perspective views, schematic rather than actual, the principle of the general type of valve I prefer to use. Figure 2 shows a nipple, constituting one actual embodiment of my invention. Figure 3 shows another nipple, of a structure embodying my invention in an exceedingly-simple form. Figure 4 shows embodiments of my invention, otherwise similar to those of Figures 2 and 3, and pictured in perspective only, but with the difference that, in these, provision is made for relieving the vacua produced within a bottle by withdrawal of all or any part of its liquid contents through a one-way outflow valve. Figure 5 discloses an embodiment of my invention in a structure that I at present prefer, for various reasons herein mentioned. Figure 6 shows still another form of my invention, presented to suggest the considerable variation possible in contriving different embodiments thereof, without departing from its essential basic features or the general scope of its structure.

Throughout the several drawings, like reference characters refer to similar elements.

Fig. 1 is a sectional view of a length of tubing closed at one end; Fig. 1*a* is a perspective view of said tubing; Fig. 1*b* is a sectional view showing a slit in the tubing in open position; and Fig. 1*c* is a perspective view corresponding to Fig. 1*c*. Fig. 2 is a sectional view through a nursing nipple embodying my invention and Fig. 2*a* is a perspective view of the nipple as shown in Fig. 2. Fig. 3 is a sectional view through a different embodiment of my invention and Fig. 3*a* is a perspective view of the nursing nipple as shown in Fig. 3. Figs. 4 and 4*a* are perspective views of a further embodiment of my invention; and Figs.

5 and 5a are sectional and perspective views, respectively, of still another embodiment of my invention. Fig. 6 is a section of a nursing nipple similar to that shown in Fig. 5 but with additional slits in the teat portion. Figs. 6 and 6a show the nursing nipple of Fig. 6 in closed and open positions, respectively.

Referring now specifically to Fig. 1, 23 is a length of soft-rubber tubing, closed at its upper end, and cut down from the top to the level 12, by the slit 13, made more or less diametrically-accurately across the tubing parallel to the plane of the drawing. The actual appearance will be more apparent from the perspective view shown in Fig. 1a, in which, however, the slit 13 is not shown parallel to the plane of the paper. With such a closed-end of a tube subjected to evacuation of a fluid from within it, as by suction acting in the direction of the vertical arrows 14—14, pressure of a fluid exterior to the tube, acting in the direction of the small arrows shown in Fig. 1a, will retain the slit 13 tightly closed, and so prevent any flow through the tube downwardly. On the other hand, positive pressure within the tube, occasioned by forcing fluid into its lower end as suggested by the vertical arrows 15—15, in the sectional view of Fig. 15 and the perspective view of Fig. 1c, will, but only if it establish itself sufficiently high, act in the direction of the small horizontal arrows of Fig. 1b and overcome the elastic resistance of the rubber, thus causing the slit 13 to gape widely in Figs. 1b and 1c, so, when under enough pressure, freely to allow one-way flow to take place in the direction of the vertical arrows 15—15. With equal pressures inside and outside of the tube 23, or with inside pressure not too much higher than that outside, the elastic quality of the soft rubber of which the tube is made serves as an effective spring to keep the slit 13 normally closed against high pressure in the direction of the arrows 14—14, and against any stated or moderate pressure in the direction of the arrows 15—15, while allowing, however, very wide and free opening of the slit 13, under some stated or required higher pressure acting in the direction of the arrows 15—15.

Referring now to Figs. 2 and 2a showing in cross section and in perspective, respectively, an actual nipple embodying the valve structure shown schematically and explained in the text hereof relating to Figs. 1, 1a, 1b and 1c. In Figs. 2 and 2a, the body of the nipple is 11, open at its lower end and provided with the annular recess 16, or with other suitable form at its base, for being stretched over or otherwise affixed so securely to the neck of a nursing bottle as to prevent leakage between nipple and bottle. The teat of the nipple terminates in the central, closed-tube portion 23, which serves as a one-way valvular orifice, normally-closed, and acting in the manner already described to prevent any outflow whatever from the nipple under moderate internal pressures, but allowing such outflow freely under higher internal pressures. The annular rim 22, separated from 23 by the groove 17, is simply to confer a generally-rounded form upon the nipple teat, and to protect the slit 13 from being accidentally held open otherwise than by the negative and positive differentials due to suction—as from tongue or lips pinching it, or becoming pinched into it. The fluid flows from the bottle into 23 through the opening 24.

Figs. 3 and 3a show in section and in perspective, respectively, how the substantially flat-ended, closed-tube, slit terminations can be effectively preserved in function while modified in appearance and form to a conventionally-rounded nipple teat, provided, however, in its concavo-convex, double-curvature surface, with the essential valvular slit 13. A fault of this perhaps simplest embodiment of my invention is that it is exposed too seriously, without protecting elements, to the shortcoming commented upon in the next-to-the-last sentence of the preceding paragraph, of possibility of having the slit opened merely by lip or tongue manipulation, in the absence of the pressure differential which, in proper normal functioning, should be the only cause of its opening.

The structure shown in Figs. 3 and 3a does not overcome a difficulty inherent in nipples with no openings therethrough, other than valvular openings functioning in an outward direction only. I refer to the fact that, in the ordinary pierced nipples of the prior art, there resides a certain advantage in that there is nothing about their structure to constrain the flow therethrough to be unidirectional. So, as the liquid food is abstracted from the bottle, and as a consequent partial vacuum is produced in the space above the liquid, rendering prohibitively-high suction necessary to draw out more liquid, this vacuum may be relieved, provided the capillary holes are not too small, by air allowed to bubble back through them each time suction is intermitted. Accordingly, Figs. 4 and 4a show how the nipple of my invention may be modified by the addition of one or more large-enough capillary orifices, 18—18, too small to allow leakage of much liquid, yet large enough to allow air to get back into the bottle, even though at an undesirably-slow rate, to relieve the vacuum in the increasing space above the liquid.

However, just as ordinary pierced nipples, unless the holes therein be excessively-large, involving the objections previously discussed herein to permanently-large openings, relieve vacua so slowly that they frequently collapse under the pressure external to them (especially if they be of the large-area, breast-type nipples used on wide-mouth bottles), so does this objection apply to the embodiment of my invention disclosed in Figs. 4 and 4a in which I show combinations of one-way valvular outflow passages with two-way capillary openings provided for inflow.

Because of the foregoing considerations, I regard the structure shown in Figs. 5 and 5a as a superior embodiment of my invention—though without departing from its essential structure other embodiments still might be found best, as continuous experiments with redesigns of the basic structure is conducted. Referring now particularly to the cross-sectional view shown in Fig. 5 and also to the perspective view in Fig. 5a, this nipple has in its teat the reentrant bulbular- or closed-tube element 23, permanently open exteriorly through the orifice 21 in the teat of the nipple, and valvularly communicating with the interior of the nipple by the slit 19, extending up to the level 20. The orifice 21 is not, therefore, to allow liquid to pass out of the nipple, it is, on the contrary, to allow air to pass in through the one-way inlet valve 19. Functioning in combination with this inlet valve, but in the contrary direction, are one or more slits, as at 13—13, constituting one-way outflow valves for the passage of liquid as in Figs. 2, 2a, 3 and 3a, excepting that in the example of Figs. 5 and 5a I show how they can be readily made multiple. This allows each slit to be made so

short that any possibility of it pinching open unwantedly as by tongue or lip is eliminated, for the slits become too short to be affected by pinching, while their multiplicity still affords a total freedom of flow comparable with that from the multiple ducts of the human breast. Moreover, short slits better withstand, with longer deferring of such damage to the rubber as may finally cause leakage, the boiling or steaming required for sterilization.

Figs. 6, 6*a* and 6*b* show an embodiment of my invention of special merit. The slits for outflow, as at 13—13—13, are disposed circumferentially instead of radially. Close examination will show that, with the alternate rings of slits staggered, the transition from the closed to the open position is very effectively secured by the stretching action shown in Fig. 6*b*.

In all embodiments of my invention, adequately exact control of the pressure ranges above which the valvular slits become operative is easily obtained by controlling the quality and thickness of the rubber, the number of the slits, their closeness to one another, and the length of the slits, as by shifting up or down the limiting points 12 and 20 at the ends of the slits.

I am aware that in the prior art there have been shown nipples with slit orifices such as my invention employs, but such structures of the prior art all have differed fundamentally from my invention in that their valving has been provided merely to let air in rather than to control the flow of liquid out; or has been designed to function by lip or mouth pressure, as by biting; or through manipulation by the nurse, as by rotation of the nipple to different positions within the mouth; instead of being designed and calibrated as are the structures of my invention, to function solely by variations in positive and negative values of fluid pressure, controlled in the fundamental design and placing of the combined elements, to become operative or inoperative as circumstances require, over predetermined pressure ranges. Hence the prior art appears to have been quite wanting in the essential elements of the structure, as well as not based upon the ascertained anatomical and physical facts, which characterize and distinguish the structure of my invention.

Obviously, embodiments of my invention not specifically-illustrated or described herein, but clearly derived or modified from the embodiments I have herein presented for illustrative and explanatory purposes, can be contrived in great variety without departing from the scope or spirit or conceptions of my invention. I therefore do not limit myself merely to the exact examples herein illustrated or described, but claim:

A nursing nipple comprising a hollow elastic body having an opening at one end adapted to fit over the neck of a nursing bottle, said hollow elastic body comprising a wall, said wall being shaped to form a teat portion at one end of said nipple, an exterior convex wall substantially bounding said teat portion, a plurality of outlet valves in said exterior convex wall comprising a plurality of slits extending transversely through the convex portion of said wall, the sides of said slits being held in surface contact under elastic pressure of the walls of the nipple so that the valve is in closed position normally and under the pressure of the maximum hydrostatic head of the contents of a nursing bottle, but in open position under the suckling pressure of an infant, a hollow bulbous member within the teat portion of the nipple, said bulbous member having an exterior concave wall, an inlet valve in said exterior concave portion comprising a slit extending transversely through said concave portion, the sides of said slit being held in surface contact under elastic pressure so that the valve is in closed position normally and under the maximum pressure of the hydrostatic head of the contents of a nursing bottle but in open position to admit air within the bottle in response to a vacuum created within the bottle by withdrawal of liquid from the bottle in response to the suckling pressure of an infant.

VICTOR LOUGHEED.