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TEATCUP LINER SERIES

ABSTRACT

A teatcup liner series, having n liners L_1 through L_n, has at least one selected parameter which varies liner to liner to provide selectable milking characteristics. The teatcup liner series is produced by a cost advantaged manufacturing method.

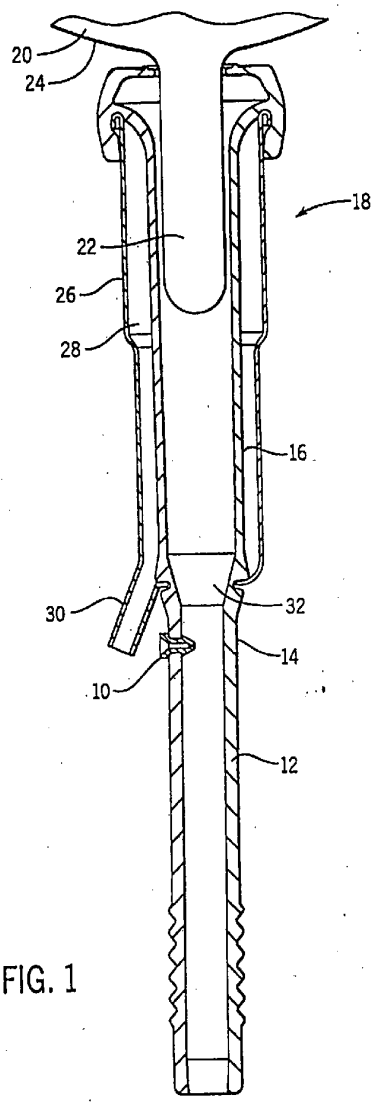

FIG. 1

P/00/011
Regulation 3.2

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COMPLETE SPECIFICATION

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Invention Title: TEATCUP LINER SERIES

The following statement is a full description of this invention, including the best method of performing it known to me:-

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TEATCUP LINER SERIES

BACKGROUND AND SUMMARY

The invention relates to teatcup liners for use in a teatcup assembly for milking a mammal.

As known in the prior art, a plurality of teatcups are connected to respective teats suspending from the udder of a mammal such as a cow. Each teatcup assembly has a teatcup liner or inflation around a respective teat and defining a milk flow passage within the liner below the teat, and a pulsation chamber outside the liner between the liner and the teatcup shell, for example U.S. Patents 4,269,143, 4,530,307, 5,178,095, 5,218,924, 6,055,931, all incorporated herein by reference. The system has a milking cycle with an on portion and an off portion. Milk flows from the teat towards a milking claw during the on portion, and then to a storage vessel. During the off portion, the liner is collapsed around the teat, to aid in the circulation of body fluids. Vacuum is continuously applied to the milk flow passage within the liner. Vacuum is alternately and cyclically applied to the pulsation chamber between the liner and the teatcup shell, to open and close the liner, all is known.

The present invention provides a liner series or family enabling the dairyman selectivity in choosing between the trade-off of liner slip versus milk harvest and milking speed. During continuing development efforts, various relationships have been discovered between various liner parameters, and in accordance therewith, a liner series has been developed having at least one and preferably a plurality of parameters which vary liner to liner in optimized manner to afford the noted selectivity.

In a further aspect of the invention, a particularly cost effective manufacturing method is provided for producing the liner series.

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In accordance with a first aspect of the present invention there is provided a teatcup liner series including: a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners L_1 through L_n having at least one selected parameter which varies from liner to liner, wherein: said lip has an axial thickness measured parallel to said axial direction; said barrel wall has a transverse thickness measured transversely to said axial direction; a first of said parameters is said axial thickness of said lip; a second of said parameters is said transverse thickness of said barrel wall; wherein in combination both of the following conditions are satisfied; said axial thickness of said lip continually increases from L_1 through L_n ; and said transverse thickness of said barrel wall continually decreases from L_1 through L_n.

In accordance with another aspect of the invention there is provided a teatcup liner series including a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners L_1 through L_n having at least one selected parameter which varies from liner to liner, wherein: said lip has an axial thickness measured parallel to said axial direction; said barrel wall has a transverse thickness measured transversely to said axial direction; said parameter is the difference between said axial thickness of said lip and said transverse thickness of said barrel wall; and said difference continually increases from L_2 through L_n.

In accordance with yet a further aspect of the present invention there is provided a method for making a teatcup liner series having in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending

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along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teat liner series including n said liners L_1 through L_n, each said liner having an outer profile surface and an inner profile surface, said method including: forming a first of said liners L_1 in a mold having a first removable core C_1 inserted therein, said mold forming the outer profile surface of liner L_1, said core C_1 forming the inner profile surface of liner L_1 ; forming a second of said liners L_2 in the same said mold having a second removable core C_2 inserted therein, said mold forming the outer profile surface of liner L_2, said core C_2 forming the inner profile surface of liner L_2 ; forming the remainder of said liners through L_n in the same said mold having respective removable cores through C_n inserted therein, said mold forming the outer profile surface of said liners through L_n, said cores through C_n forming the inner profile surfaces of the liners through L_n, wherein: the same said mold is used for each of said liners L_1 through L_n ; the outer profile surface is the same for each of said liners L_1 through L_n ; different cores C_1 through C_n are used for said liners L_1 through L_n ; and said inner profile surface is different from liner to liner according to C_1 through C_n.

In accordance with yet another aspect of the present invention there is provided a teatcup liner series including in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners L_1 through L_n having at least one selected parameter which varies from liner to liner, wherein: said lip has an axial thickness measured parallel to said axial direction; said barrel wall has a transverse thickness measured transversely to said axial direction; said parameter is the difference between said axial thickness of said lip and said transverse thickness of said barrel wall; and said difference increases linearly from L_1 through L_n.

In accordance with yet a further aspect of the present invention there is provided a teatcup liner series including in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners 14 through L_n having at least two selected parameters which vary from liner to liner, wherein: said lip has an axial thickness measured parallel to said axial direction; said barrel wall has a transverse thickness measured transversely to said axial direction; one of said parameters is the difference between said axial thickness of said lip and said transverse thickness of said barrel wall; and said difference increases from L_1 through L_n.

In accordance with yet another aspect of the present invention there is provided a teatcup liner series including in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners L_1 through L_n having at least two selected parameters which vary from liner to liner, wherein: said lip has an axial thickness A measured parallel to said axial direction; said barrel wall has a transverse thickness B measured transversely to said axial direction; one of said parameters is A; another of said parameters is B; and A and B vary inversely and linearly relative to each other from L_1 through L_n.

In accordance with yet another aspect of the present invention there is provided a teatcup liner series including in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said

teat, said teatcup liner series including n said liners L_1 through L_n having at least three selected parameters which vary from liner to liner, wherein: said lip has an axial thickness A measured parallel to said axial direction; said barrel wall has a transverse thickness B measured transversely to said axial direction; one of said parameters is A; another of said parameters is B; and A and B vary inversely relative to each other from L_1 through L_n.

In accordance with yet another aspect of the present invention there is provided a teatcup liner series including in combination a family of related teatcup liners, each liner having an upper mouthpiece and a barrel depending downwardly from said upper mouthpiece, said barrel extending axially along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including in combination n said liners L_1 through L_n having at least one selected parameter which varies liner to liner, said lip having an axial thickness measured parallel to said axial direction, wherein said parameter is said axial thickness of said lip.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is taken from U.S. Patent 6,055,931 and is a side view partially in section of a teatcup assembly including a teatcup liner for milking a mammal.

Fig. 2 is an isometric view of a teatcup liner.

Fig. 3 shows a teatcup liner series in accordance with the invention.

Fig. 4 is a graphical plot of a selected parameter which varies in accordance with the invention.

Fig. 5 is a graphical plot of the variance of a pair of parameters versus each other in accordance with the invention.

Fig. 6 is a graphical plot of the variance of another pair of parameters versus each other in accordance with the invention.

Fig. 7 is a graphical plot of the variance of another pair of parameters versus each other in accordance with the invention.

Fig. 8 is a graphical plot of the variance of another pair of parameters versus each other in accordance with the invention.

Fig. 9 is a graphical plot of the variance of another pair of parameters versus each other in accordance with the invention.

Fig. 10 is a cross-sectional view of a liner.

Fig. 11 is like Fig. 10 and shows another embodiment.

Fig. 12 is like Fig. 10 and shows another embodiment.

Fig. 13 is like Fig. 10 and shows another embodiment.

Fig. 14 is like Fig. 10 and shows another embodiment.

Fig. 15 is like Fig. 10 and shows another embodiment.

Fig. 16 is like Fig. 3 and illustrates a manufacturing method in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows a teatcup assembly 18 for milking a mammal 20 such as a cow. Teat 22 suspending from udder 24 of the mammal extends into the liner. Teatcup

shell 26 is typically a metal, or plastic, member defining an annular pulsation chamber 28 around liner 16 between the liner and the teatcup shell and having a pulsation port 30 for connection to a pulsator valve, as is known. Liner 16 is typically rubber or other flexible material. The lower end of milk tube portion 14 of the liner is connection to a claw, for example U.S. Patents 4,537,152 and 5,291,853, incorporated herein by reference, which in turn supplies milk to a storage vessel. As noted above, vacuum is continuously applied to milk passage 32 within the liner through milk tube portion 14, and vacuum is alternately and cyclically applied to pulsation chamber 28 through port 30, to open and close liner 16 below teat 22, all as is known and for which further reference may be had to the above noted incorporated patents. An air vent plug 10 may be inserted through the wall 12 of the milk tube portion 14 of the teat liner, as is known, for example above noted incorporated U.S. Patent 6,055,931. For further background, a teat liner is illustrated in isometric view at 34 in Fig. 2.

Fig. 3 illustrates a teatcup liner series in accordance with the invention including in combination a plurality of related teatcup liners comprising n liners L_1 through L_n, for example as shown at the nine liners L_1 through L_9. Each liner such as 40 has an upper mouthpiece 42, an intermediate barrel 44 defined by a barrel wall 46, and a lower connecting tube 48. The barrel extends along an axial direction 50 for receiving teat 22 inserted axially thereinto through mouthpiece 42. The mouthpiece has an upper lip 52 having an aperture 54 therethrough for receiving teat 22. Lip 52 has an axial thickness A measured parallel to axial direction 50. Barrel wall 46 has axially spaced upper and lower portions 56 and 58. Upper portion 56 of barrel wall 46 has a transverse thickness B measured transversely to axial direction 50. Lower portion 58 of barrel wall 46 has a transverse thickness C measured transversely to axial direction 50. Upper portion 56 of barrel wall 46 has inner surfaces 60 defining a hollow interior with an upper transverse span D thereacross taken transversely to axial direction 50. Lower portion 58 of barrel wall 46 has inner surfaces 62 defining a hollow interior with a lower transverse span E thereacross taken transversely to

axial direction 50. Lip aperture 54 has a transverse dimension taken transversely to axial direction 50 and defining a mouthpiece bore F. Mouthpiece 42 has a cavity 64 between lip 52 and barrel 44. Cavity 64 has a transverse dimension taken transversely to axial direction 50 and defining a cavity bore G. Cavity 64 has a volume H.

In one preferred embodiment, the noted parameters A through H are varied liner to liner from L_1 through L_9 as indicated in the table below, and as set forth in Fig. 3. The table below gives dimensions for A through G in millimeters (mm). For example, the axial thickness A of lip 52 varies from 2.0mm for liner L_1 to 3.6mm for liner L_9. The table gives dimensions in cubic inches (in^3) for H.

TABLE

	LINER								
	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9
A(mm)	2.0	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
B(mm)	3.2	3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.4
C(mm)	2.9	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.1
D(mm)	20.2	20.4	20.6	20.8	21	21.2	21.4	21.6	21.8
E(mm)	18.9	19.1	19.3	19.5	19.7	19.9	20.1	20.3	20.5
F(mm)	20.4	20.3	20.2	20.1	20.0	19.9	19.8	19.7	19.6
G(mm)	52.95	52.65	52.25	51.85	51.45	51.05	50.65	50.25	49.85
H(in^3)	1.368	1.353	1.336	1.318	1.301	1.283	1.265	1.248	1.230
A-B(mm)	-1.2	-0.9	-0.6	-0.3	0	0.3	0.6	0.9	1.2

The liner series is characterized by the following relationships, as illustrated in the table and Fig. 3: axial thickness A of lip 52 continually increases from L_1 through L_n, preferably linearly; transverse thickness of barrel wall 46, including both B and C, continually decreases from L_1 through L_n, preferably linearly; the transverse span across the hollow interior, including both D and E, continually increases from L_1 through L_n, preferably linearly; mouthpiece bore F continually

decreases from L_1 through L_n, preferably linearly; cavity bore G continually decreases from L_1 through L_n, preferably linearly; cavity volume H continually decreases from L_1 through L_n.

In the preferred embodiment, B is always greater than C, and D is always greater than E, such that both the barrel wall thickness and the noted transverse span are tapered. In alternate embodiments, the barrel wall thickness and/or the transverse span may be untapered, i.e. straight.

Further, in the preferred embodiment, the parameter A-B, i.e. the difference between A and B, varies as illustrated in the table, namely such difference continually increases from L_1 through L_9, preferably linearly, as further illustrated in Fig. 4.

Further, in the preferred embodiment, in a plot, Fig. 5, of transverse thickness B of barrel wall 46 versus axial thickness A of lip 52 for liners L_1 through L_9, B decreases as A increases. Further preferably, B decreases linearly with respect to A.

Further in the preferred embodiment, in a plot, Fig. 6, of transverse span D versus axial thickness A of lip 52 for L_1 through L_9, D decreases as A increases. Further preferably, D decreases linearly with respect to A.

Further in the preferred embodiment, in a plot, Fig. 7, of axial thickness A of lip 52 versus mouthpiece bore F for L_1 through L_9, axial thickness A decreases as mouthpiece bore F increases. Further preferably, A decreases linearly with respect to F.

Further in the preferred embodiment, in a plot, Fig. 8, of axial thickness A of lip 52 versus cavity bore G for L_1 through L_9, axial thickness A decreases as cavity bore G increases. Further preferably, A decreases linearly with respect to G.

Further in the preferred embodiment, in a plot, Fig. 9, of axial thickness A of lip 52 versus cavity volume H for L_1 through L_9, axial thickness A decreases as cavity volume H increases. Further preferably, A decreases linearly with respect to H.

The disclosed combination enables selection of desired milking characteristics. Liner L_1 provides the highest milk harvest and highest milk speed, but also the greatest liner slip. Liner L_9 provides the lowest liner slip and also the lowest milk harvest and milking speed. The dairyman can choose the right balance and trade-off for his particular needs. As he moves left to right in Fig. 3, liner slip reduces as does milk harvest and milking speed. As he moves right to left in Fig. 3, liner slip increases as does milk harvest and milking speed.

The liner is preferably round as shown at 66 in Fig. 10. The liner may additionally include a plurality of ribs such as 68, Figs. 11 and 2, extending axially along the barrel. The ribs may be external as shown, and/or internal. The liner may be triangular as shown at 70 in Fig. 12. The liner may be square as shown at 72 in Fig. 13. The liner may be oval as shown at 74 in Fig. 14. The liner may be fluted as shown at 76 in Fig. 15.

The various combinations of parameters providing the noted selectivity of milking characteristics are set forth in the claims. Deflection of lip 52 is varied by parameter A, and may additionally or alternately be varied by varying the shore hardness of the lip material. Liner barrel tension is varied by varying the noted wall thickness B and C, and may alternately or additionally be varied by the addition of the noted ribs and/or changing the cross-section of individual ribs and/or changing liner material and/or changing barrel length.

There is further provided a simple and particularly cost effective and economical manufacturing method for making the teatcup liner series. The method involves: forming a first of the liners L_1 in a mold 80, Fig. 16, having a first removable core C_1 inserted therein, the mold forming the outer profile surface 82 of liner L_1, the core C_1 forming the inner profile surface 84 of liner L_1; forming a second of the liners L_2 in the same mold 80 having a second removable core C_2 inserted therein, the mold 80 forming the outer profile surface 86 of liner L_2, the core C_2 forming the inner profile surface 88 of liner L_2; forming the remainder of the liners through L_n, e.g. L_3 through L_9, in the same mold 80 having respective

removable cores through C_n, e.g. C_3 through C_9, inserted therein, the mold 80 forming the outer profile surface of the liners through L_n, the cores through C_n forming the inner profile surfaces of the liners through L_n, e.g. cores C_3 through C_9 form the inner profile surfaces for liners L_3 through L_9, respectively. The same mold 80 is used for each of the liners L_1 through L_9. The outer profile surface is the same for each of liners L_1 through L_9. Different cores C_1 through C_9 are used for liners L_1 through L_9. The inner profile surface is different from liner to liner according to C_1 through C_9. Any or all or some combination of the noted parameters A-H are varied liner to liner according to C_1 through C_9. The cores change a selected dimensional parameter or parameters. This is particularly desirable from a manufacturing standpoint because of the savings in tooling cost by using a single mold to produce the liner series, rather than multiple molds, i.e. one for each liner. Instead, different cores are used to provide the variance liner to liner in the series. Cores are significantly less expensive than a mold.

It is recognized that various equivalents, alternatives and modifications are possible within the scope of the appended claims.

Where the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification, they are to be interpreted as specifying the presence of the stated features, integers, steps or components referred to, but not to preclude the presence or addition of one or more other feature, integer, step, component or group thereof.

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The claims defining the invention are as follows:

1. A teatcup liner series including:

a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners L_1 through L_n having at least one selected parameter which varies from liner to liner, wherein:

said lip has an axial thickness measured parallel to said axial direction;

said barrel wall has a transverse thickness measured transversely to said axial direction;

a first of said parameters is said axial thickness of said lip;

a second of said parameters is said transverse thickness of said barrel wall;

wherein in combination both of the following conditions are satisfied;

said axial thickness of said lip continually increases from L_1 through L_n ; and

said transverse thickness of said barrel wall continually decreases from L_1 through L_n.

2. A teatcup liner series including a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners L_1 through L_n having at least one selected parameter which varies from liner to liner, wherein:

said lip has an axial thickness measured parallel to said axial direction;

said barrel wall has a transverse thickness measured transversely to said axial direction;

said parameter is the difference between said axial thickness of said lip and said transverse thickness of said barrel wall; and

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said difference continually increases from L_2 through L_n.

3. A method for making a teatcup liner series having in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teat liner series including n said liners L_1 through L_n, each said liner having an outer profile surface and an inner profile surface, said method including:

forming a first of said liners L_1 in a mold having a first removable core C_1 inserted therein, said mold forming the outer profile surface of liner L_1, said core C_1 forming the inner profile surface of liner L_1 ;

forming a second of said liners L_2 in the same said mold having a second removable core C_2 inserted therein, said mold forming the outer profile surface of liner L_2, said core C_2 forming the inner profile surface of liner L_2 ;

forming the remainder of said liners through L_n in the same said mold having respective removable cores through C_n inserted therein, said mold forming the outer profile surface of said liners through L_n, said cores through C_n forming the inner profile surfaces of the liners through L_n,

wherein:

the same said mold is used for each of said liners L_1 through L_n ;

the outer profile surface is the same for each of said liners L_1 through L_n ;

different cores C_1 through C_n are used for said liners L_1 through L_n ; and

said inner profile surface is different from liner to liner according to C_1 through C_n.

4. The method according to claim 3, wherein said n liners L_1 through L_n have at least one selected parameter which varies from liner to liner, and wherein said at least one selected parameter varies from liner to liner according to C_1 through C_n.

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5. The method according to claim 4, wherein said at least one selected parameter is a dimension.

6. The method according to claim 5, wherein said lip has an axial thickness measured parallel to said axial direction, and said at least one parameter is said axial thickness of said lip.

7. The method according to claim 5 or claim 6, wherein said barrel wall has a transverse thickness measured transversely to said axial direction, and said at least one parameter is said transverse thickness of said barrel wall.

8. The method according to any one of claims 5 to 7, wherein said barrel wall has inner surfaces defining a hollow interior with a transverse span thereacross taken transversely to said axial direction, and wherein at least one said parameter is said transverse span.

9. The method according to any one of claims 5 to 8, wherein said lip aperture has a transverse dimension taken transversely to said axial direction and defining a mouthpiece bore, and wherein said at least one parameter is said mouthpiece bore.

10. The method according to claim any one of claims 5 to 9, wherein said mouthpiece has a cavity between said lip and said barrel, and said cavity has a transverse dimension taken transversely to said axial direction and defining a cavity bore, and wherein said at least one parameter is said cavity bore.

11. The method according to any one of claims 5 to 10, wherein said mouthpiece has a cavity between said lip and said barrel, said cavity having a volume, and wherein said at least one parameter is said cavity volume.

12. A teatcup liner series including in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial

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direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners L_1 through L_n having at least one selected parameter which varies from liner to liner, wherein:

said lip has an axial thickness measured parallel to said axial direction;

said barrel wall has a transverse thickness measured transversely to said axial direction;

said parameter is the difference between said axial thickness of said lip and said transverse thickness of said barrel wall; and

said difference increases linearly from L_1 through L_n.

13. A teatcup liner series including in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners 14 through L_n having at least two selected parameters which vary from liner to liner, wherein:

said lip has an axial thickness measured parallel to said axial direction;

said barrel wall has a transverse thickness measured transversely to said axial direction;

one of said parameters is the difference between said axial thickness of said lip and said transverse thickness of said barrel wall; and

said difference increases from L_1 through L_n.

14. A teatcup liner series including in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners L_1 through L_n having at least two selected parameters which vary from liner to liner, wherein:

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said lip has an axial thickness A measured parallel to said axial direction;

said barrel wall has a transverse thickness B measured transversely to said axial direction;

one of said parameters is A;

another of said parameters is B; and

A and B vary inversely and linearly relative to each other from L_1 through L_n.

15. A teatcup liner series including in combination a plurality of related teatcup liners, each liner having an upper mouthpiece, an intermediate barrel defined by a barrel wall, and a lower connecting tube, said barrel extending along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including n said liners L_1 through L_n having at least three selected parameters which vary from liner to liner, wherein:

said lip has an axial thickness A measured parallel to said axial direction;

said barrel wall has a transverse thickness B measured transversely to said axial direction;

one of said parameters is A;

another of said parameters is B; and

A and B vary inversely relative to each other from L_1 through L_n.

16. A teatcup liner series including in combination a family of related teatcup liners, each liner having an upper mouthpiece and a barrel depending downwardly from said upper mouthpiece, said barrel extending axially along an axial direction for receiving a teat inserted axially thereinto through said mouthpiece, said mouthpiece having an upper lip having an aperture therethrough for receiving said teat, said teatcup liner series including in combination n said liners L_1 through L_n having at least one selected parameter which varies liner to liner, said lip having an axial thickness measured parallel to said axial direction, wherein said parameter is said axial thickness of said lip.

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17. The teatcup liner series according to claim 16, wherein said axial thickness of said lip progressively increases from L_1 through L_n.

18. A teatcup liner series, substantially as described herein with reference to the accompanying drawings.

19. A method for making a teatcup liner series, substantially as described herein with reference to the accompanying drawings.

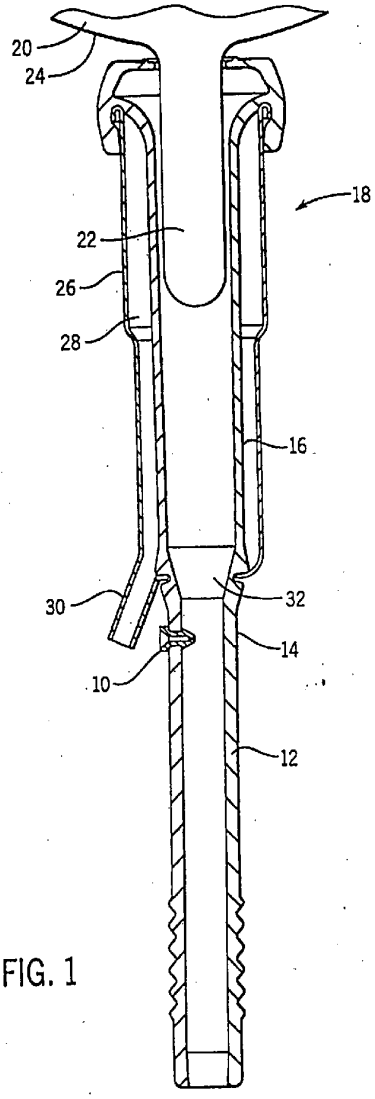

FIG. 1

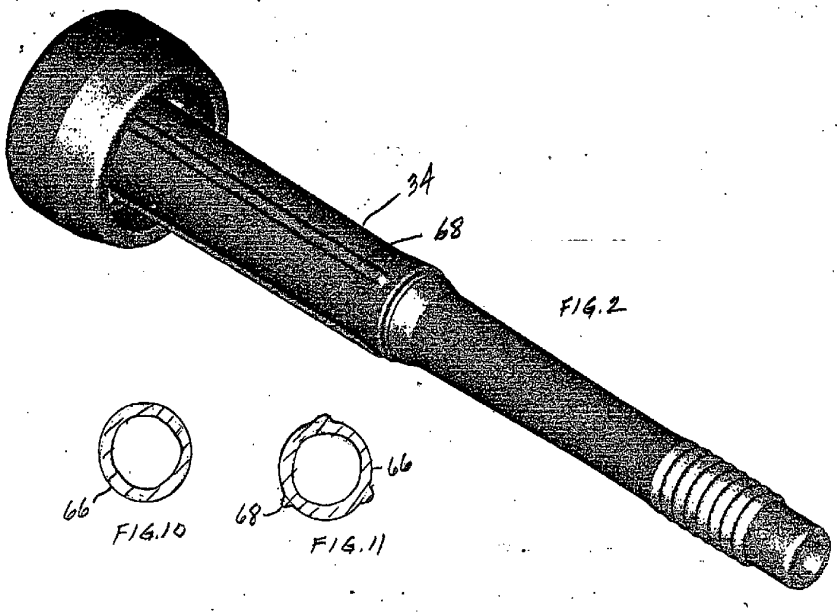

FIG. 2

FIG. 10

FIG. 11

FIG. 12

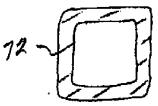

FIG. 13

FIG. 14

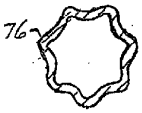

FIG. 15

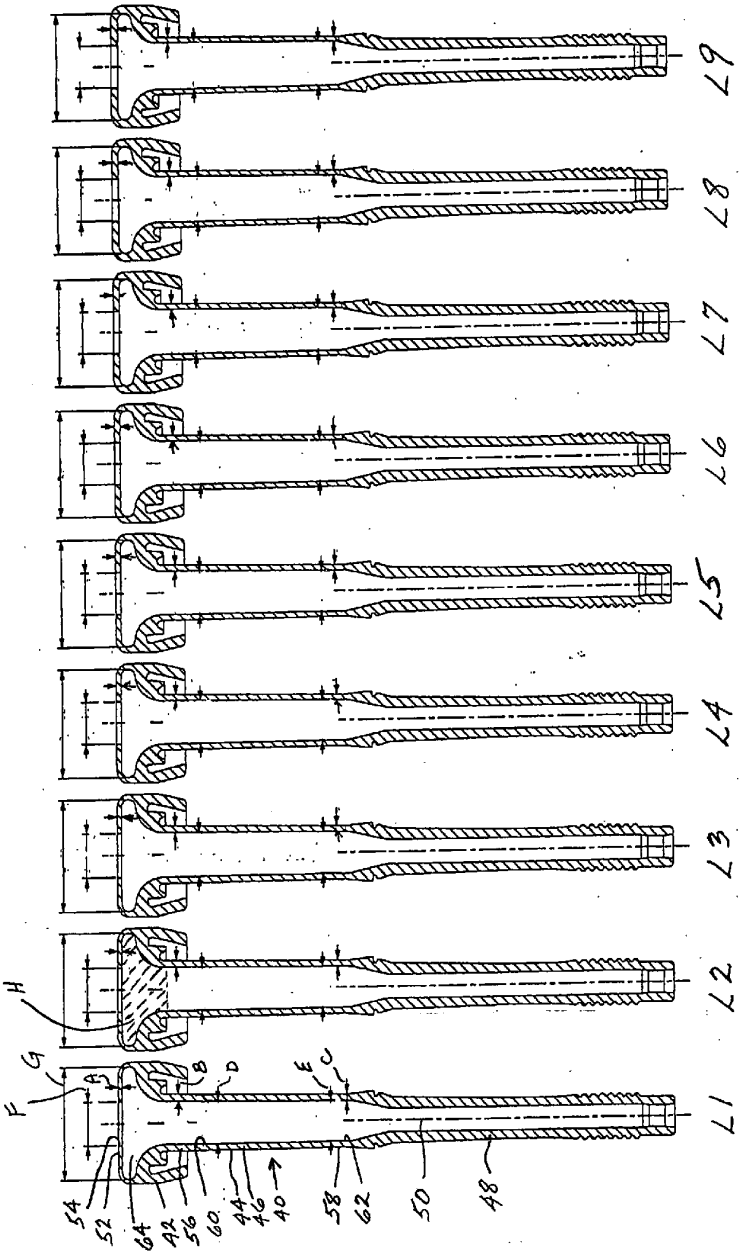
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FIG. 3

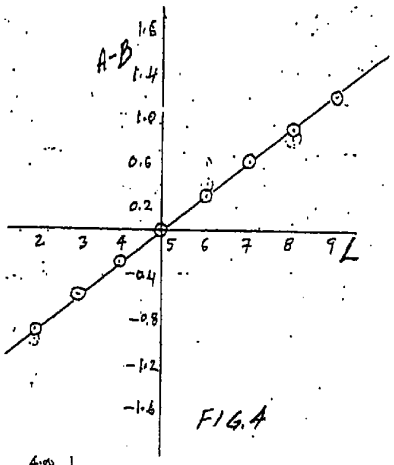

FIG. 4

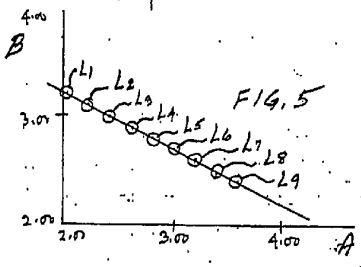

FIG. 5

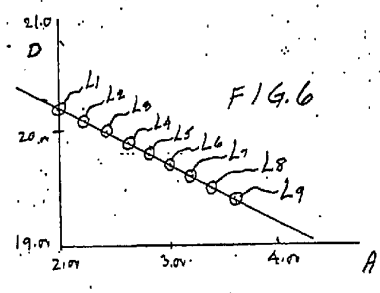

FIG. 6

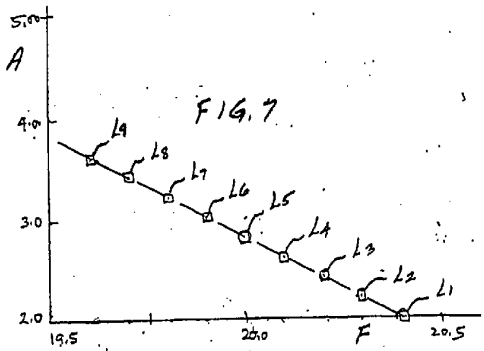

FIG. 7

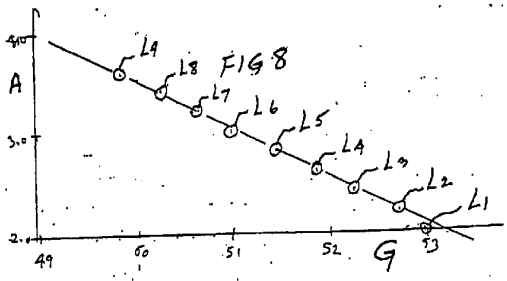

FIG 8

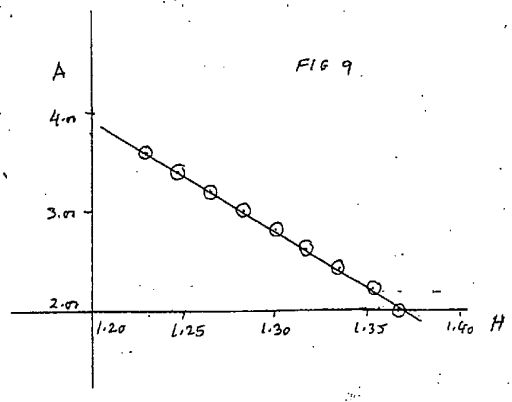

FIG 9

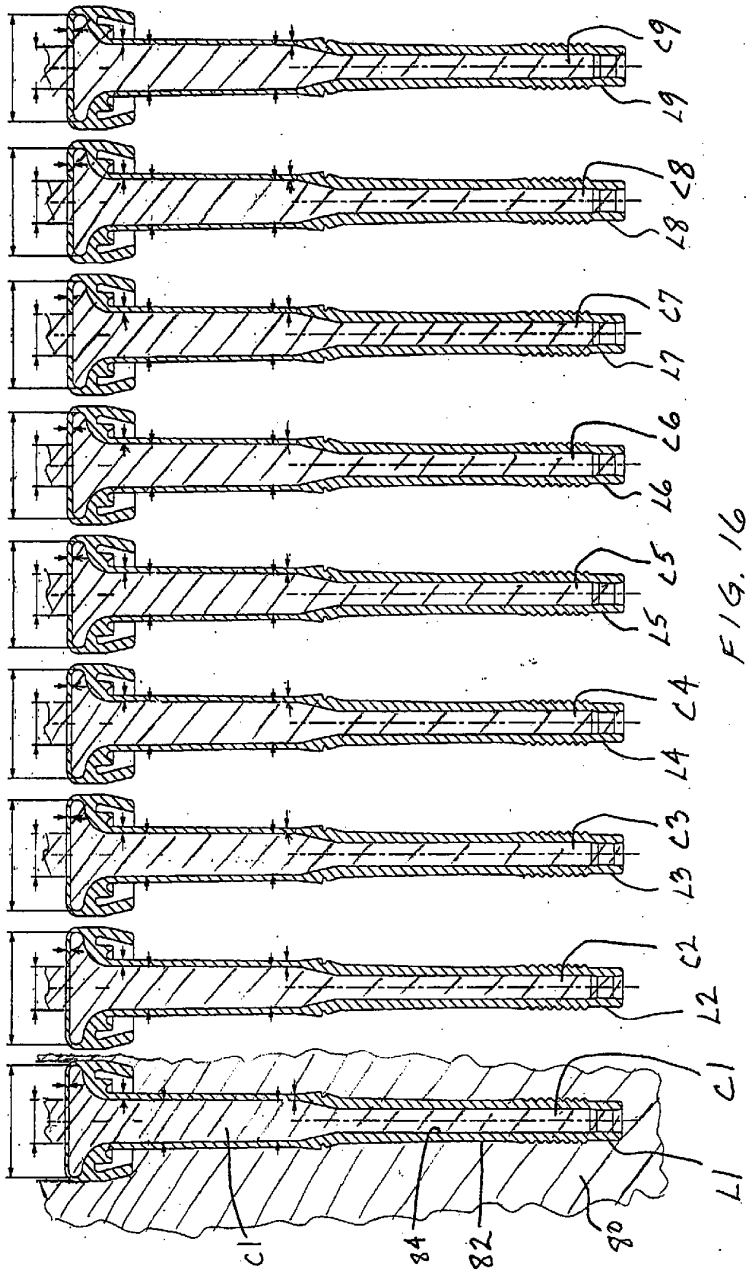

FIG. 16