

- [54] **ARTIFICIAL INSEMINATION APPARATUS**
 [76] Inventor: **Horst K. Wieder**, 1207 Riverview Ln., Watertown, Wis. 53094
 [22] Filed: **July 17, 1974**
 [21] Appl. No.: **489,169**
 [52] U.S. Cl. **128/235; 128/272; 128/218 P**
 [51] Int. Cl. **A61m 37/02; A61d 7/02**
 [58] Field of Search 128/218 P, 218 D, 234-238, 128/261, 260, 272; 222/386, 386.5, 92, 105

3,791,560 2/1974 Harris, Sr. 222/386
 3,805,784 4/1974 Alter 128/260

Primary Examiner—Richard A. Gaudet
Assistant Examiner—J. C. McGowan
Attorney, Agent, or Firm—John M. Diehl

[56] **References Cited**

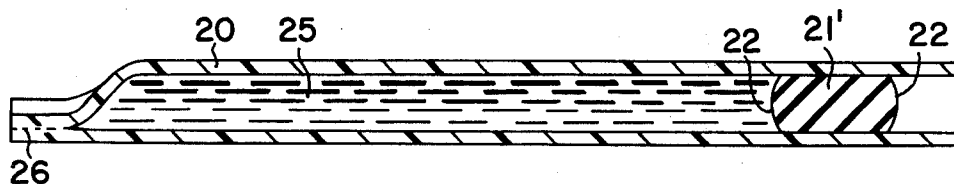
UNITED STATES PATENTS

2,066,868	1/1937	Whittaker	128/234
2,361,647	10/1944	Nyden	128/236 X
2,552,403	5/1951	Carlson	128/235
2,572,155	10/1951	Hoyt	128/234
2,572,987	10/1951	Coles et al.	128/238
2,880,913	4/1959	Peyron	222/386 X
3,507,281	4/1970	Cassou	128/235
3,766,918	10/1973	Kessel	128/272

[57] **ABSTRACT**

Disposable apparatus to artificially inseminate animals includes ampoule, usually referred to as a straw. Semen is retained in the straw by a heat sealed closure at one end and a deformed resilient ball at the other which acts as both piston and seal. The straw is insertable in a disposable sheath tube after cutting off the heat sealed closure end. No gun is required. Contents of the straw are expelled with a disposable push rod acting on the ball to operate it as a piston. The device has the advantages of greater reliability and prevention of fraud. It reduces cost and eliminates all sterilization of equipment subsequent to original manufacture.

7 Claims, 16 Drawing Figures



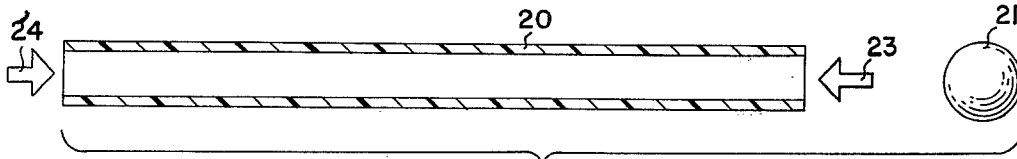


Fig. 1.

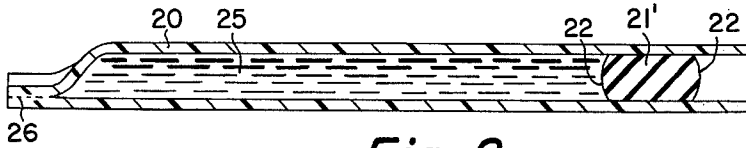


Fig. 2.

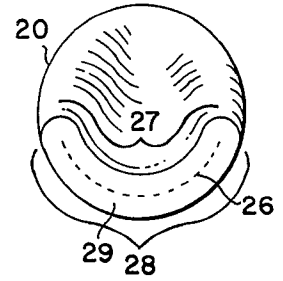


Fig. 3.

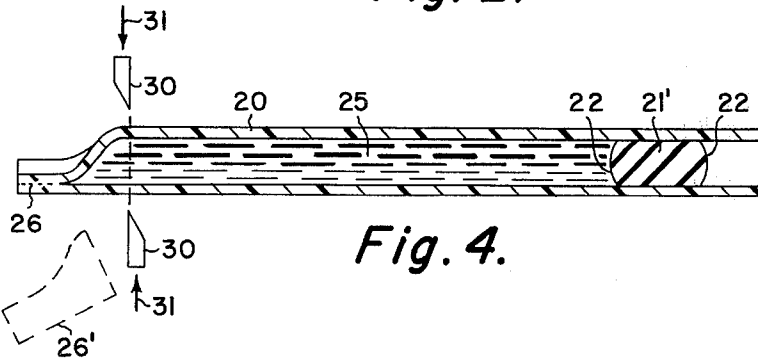


Fig. 4.

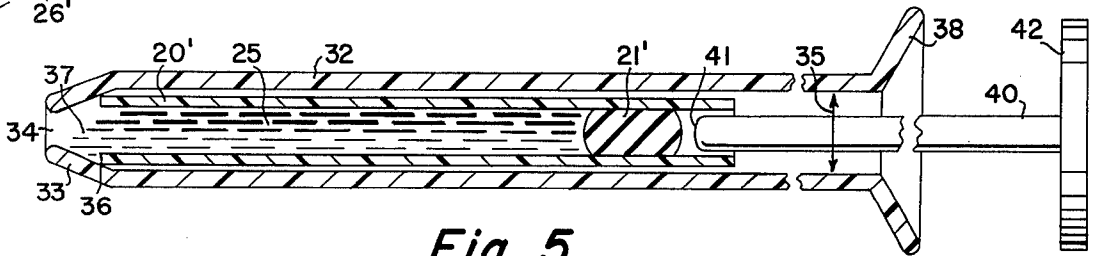


Fig. 5.

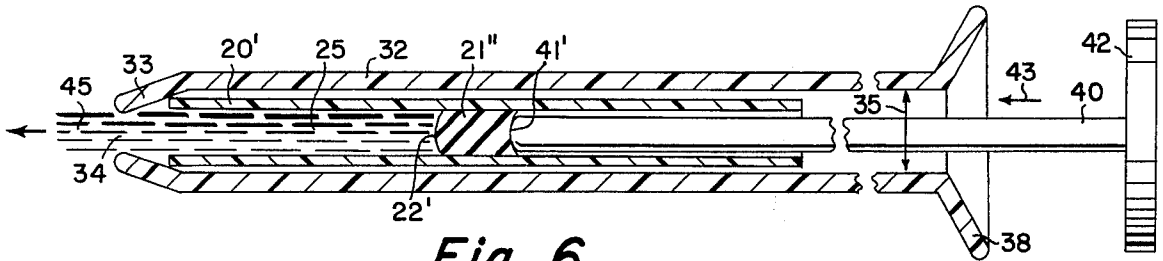


Fig. 6.

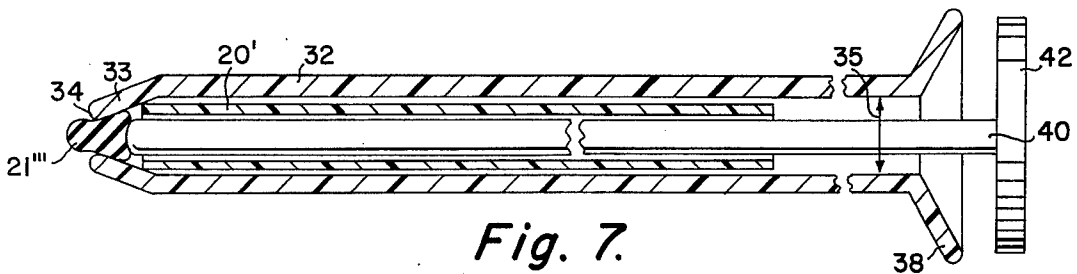


Fig. 7.

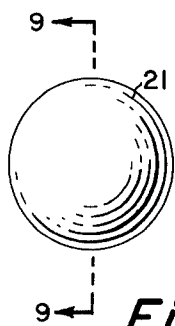


Fig. 8.

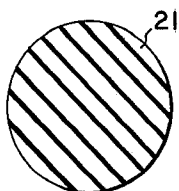


Fig. 9.

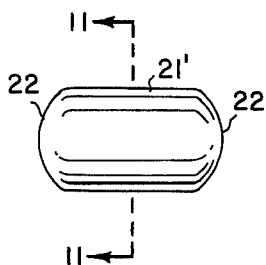


Fig. 10.

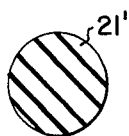


Fig. 11.

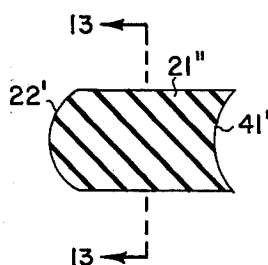


Fig. 12.

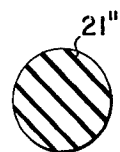


Fig. 13.

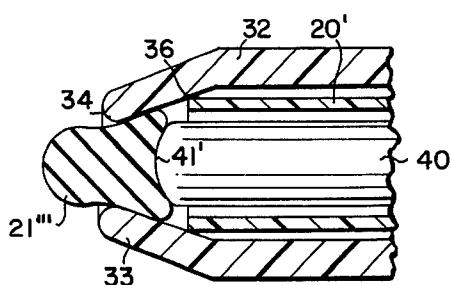


Fig. 14.

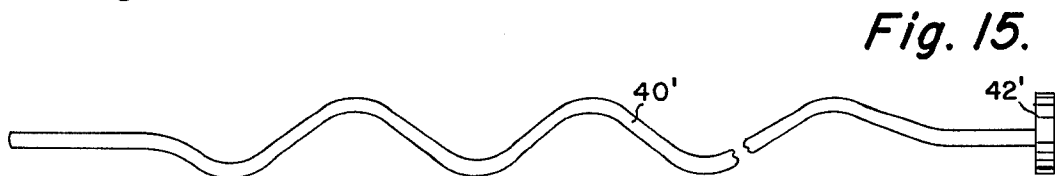


Fig. 15.

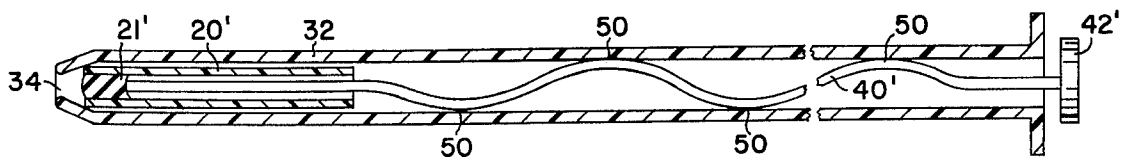


Fig. 16.

ARTIFICIAL INSEMINATION APPARATUS

FIELD

This invention relates to artificial insemination apparatus and more particularly to such apparatus involving use of a straw of synthetic resinous polymeric material in place of breakable glass ampoules or other containers previously used.

PRIOR ART

The device of the invention is an improvement on the following U.S. Pat. Nos. taken individually or in combination:

2,503,341	2,587,984	3,256,884
2,510,249	2,702,548	3,343,539
2,552,403	2,841,146	3,380,453
2,566,632	2,942,603	3,507,281
2,572,155	3,050,060	3,712,303
2,572,987		

The device is particularly an improvement over the disclosure of U.S. Pat. No. 3,507,281 issued Apr. 21, 1970, to R. K. Cassou in that in the instant device, unlike that of the disclosure, all parts are disposable so that repeated sterilization of certain parts is not necessary in the present device as it is with the previously disclosed device. Furthermore, leakage which is common with the seals of the previous device is eliminated in the present invention. Furthermore, the instant device is less complex, having fewer parts, and having parts of substantially less complexity.

The apparatus disclosed in said patent is widely distributed and generally the straws are provided with identical sealing members at each end. Instead of cutting off merely the end of the straw containing the sealing member at one end, prior to usage, it is not unusual for an operator to cut the straw in the middle and use each half as if it were an entire straw. If this is done without the knowledge of the owner of the animal being inseminated, it may be fraudulent with respect to said owner or at least unfair with respect to him because the likelihood of achieving pregnancy is substantially reduced since the quantity placed in the straw originally is carefully selected to be of suitable quantity for achieving insemination.

The device of the present invention is furthermore particularly an improvement over the disclosure of U.S. Pat. No. 3,257,884 in eliminating leakage past the piston, such leakage having been observed with the previously disclosed device of U.S. Pat. No. 3,257,884.

The present device is furthermore particularly an improvement over the disclosure of U.S. Pat. No. 2,841,146, in providing parts, all of which are disposable and none of which need be repeatedly sterilized. It may be noted that the disclosure of U.S. Pat. No. 2,841,146 describes a ball or spherical member 46 which unlike the spherical piston member of the present invention is not deformed when received in a straw and is not further deformed during use. Also said ball does not act as a piston to drive semen out of the tube in which it is received but serves only as a seal after semen introduction is accomplished by other means.

SUMMARY

Improved artificial insemination apparatus comprises a straw, a sheath tube and a push rod or pusher member. The straw is a tubular member of about 2 to 4 mil-

limeters outside diameter having a wall thickness of about 0.005 to 0.010 inch, about 0.007 inch being preferable. The straw is preferably extruded as a continuous tubular member and is cut automatically into preselected lengths which may be on the order of five centimeters or 6 centimeters. A spherical piston member of polymeric elastomeric material such as synthetic rubber having a diameter larger than the outside diameter of the straw is then inserted in one end of each straw, the spherical member being deformed into a cylindrical member with ends which may be described as convex or as arcuately curvedly convexly outwardly extending.

The straws are then filled with semen using a filling machine which is not part of the present invention, the end through which each is filled being the end opposite that in which the piston member is inserted. Each tube is then heat sealed with the same machine in the manner more fully described hereinafter. To identify the contents of each straw, the straw may be printed prior to filling or may be printed after filling or may be printed in the same machine in which filling is accomplished.

The straws then are generally inserted in or attached to a "cane" which may hold a preselected number of straws such as 4, 5 or 6, the precise form of the cane not being part of the present invention and they are immersed in a cooling fluid such as liquid nitrogen in accordance with well established practice to accomplish refrigeration at a preselected rate and to maintain a desired cryogenic refrigeration temperature.

When it is desired to use a straw to inseminate an animal, a cane is withdrawn from storage, a straw is removed therefrom and the straw is heated in accordance with a preselected regimen. It has been common to heat straws in a pocket of the wearer's apparel or in some other imprecise manner. It has been found however that a preselected heating regimen is preferable and such preselected regimen may be accomplished by means which are not part of the present invention.

The heat sealed end of the straw is then cut off. This operation may be accomplished with particular suitability with apparatus to be described in a co-pending application which has the object of making the cut on a plane normal to the axis of the straw and cutting off a precisely preselected amount of the end of the straw sufficient to remove all of the heat sealed closure member but otherwise having the object of removing as little of the remainder of the straw as possible in order to prevent removal of a significant portion of the contents.

The straw may then be inserted in a sheath tube more fully described hereinafter and a disposable push rod of plastic material may be inserted. The assembly may then be inserted in an animal to be impregnated and the push rod operated to drive the piston through the straw expelling its contents through the open end of the straw and thence through the exit orifice of the sheath tube. The piston member of the invention may be driven out of the straw and partially extruded through the exit orifice of the sheath tube in order to insure removal from the interior of both the straw and the sheath tube of the maximum amount of the semen.

Particular advantages of the apparatus of this invention include: leakage of the contents of straws past piston members which have been observed with straws in

pistons heretofore used is substantially entirely eliminated with the present device.

All the apparatus utilized in accomplishing insemination of an animal is disposable so that no re-sterilization (with attendant dangers of infection due to inadequate sterilization) is needed.

Another advantage is that the straw of the invention may be subjected to somewhat extreme mechanical abuse without causing loss of the contents: a pressure of 200 pounds per square inch may be exerted, it has been found, by the piston on the contents of the straw without causing leakage of the contents through the heat sealed end of the straw and without causing leakage of the contents past the piston and without causing rupture of the walls of the straw. Although such resistance to 200 psi is believed to be achieved in substantially every straw made, it is considered that resistance to 50 psi is sufficient to provide the desired high quality and high resistance to damage and leakage. Such pressure is obtained simply by operation of the push rod or pusher member hereinafter described against the piston without prior removal of the heat sealed closure at the other end of the straw.

OBJECTS

It is therefore an object of the invention to provide an improved artificial insemination apparatus.

Another object is such an apparatus wherein leakage of the contents of the straw past the piston in the straw is eliminated.

Another object is such apparatus wherein all parts used in accomplishing insemination of an animal are disposable and need not be re-sterilized.

Another object is such apparatus wherein all parts used in insemination of an animal are relatively low in cost.

Another object is such apparatus which is more reliable, that is, provides highest ratio of successful inseminations to insemination attempts by reducing or eliminating breakage, eliminating leakage past the piston member and insuring more consistent use of a maximum proportion of the contents of each straw.

Other objects will become apparent from the drawings and from the following detailed description in which it is intended to illustrate the applicability of the invention without thereby limiting its scope to less than that of all equivalents which will be apparent to one skilled in the art.

DRAWINGS

In the drawings like reference numerals refer to like parts and:

FIG. 1 is a side elevation showing a first step in providing a filled straw;

FIG. 2 is a cross-sectional view taken on lines 2—2 in FIG. 3 showing a filled and heat sealed straw with piston member inserted;

FIG. 3 is an end elevation of the embodiment of FIGS. 2 and 4 taken from the heat sealed end;

FIG. 4 is a cross-sectional elevation showing a first step in utilization of a filled straw;

FIG. 5 is a cross-sectional elevation showing another step in utilization of a filled straw;

FIG. 6 is a cross-sectional elevation showing a further step in utilization of a filled straw and showing the changed configuration of the piston member during such step;

FIG. 7 is a cross-sectional elevation showing another change in configuration of the piston member;

FIG. 8 is an elevation of the piston member of FIGS. 1, 2 and 4—7 prior to insertion in a straw;

FIG. 9 is a cross-sectional view of the piston member of FIG. 8 taken on lines 9—9 in FIG. 8;

FIG. 10 is a side elevation of the piston member of FIGS. 8 and 9 after being received in a straw;

FIG. 11 is a cross-sectional view taken on lines 11—11 in FIG. 10;

FIG. 12 is a cross-sectional view corresponding to the view of FIG. 10 of the piston member of FIGS. 8, 9, 10 and 11 after application of a push rod member to the right end thereof;

FIG. 13 is a cross-sectional view of the piston of FIGS. 8—12, being taken in a manner corresponding to that indicated by lines 13—13 in FIG. 12;

FIG. 14 is an enlarged cross-sectional fragmentary view showing the configuration of the piston shown in FIG. 7;

FIG. 15 is a side elevation of a modification of the pusher member of FIGS. 5, 6 and 7; and

FIG. 16 is a cross-sectional view showing the pusher of FIG. 15 received in a sheath tube.

DESCRIPTION

Referring now to FIG. 1, straw 20 may have spherical piston member 21 inserted therein as indicated by arrow 23 and may then be filled with semen-containing liquid as indicated by arrow 24 to provide fluid within straw 20 as shown at 25 in FIG. 2. After piston member 21 is inserted into straw 20 as indicated by arrow 23 it is distorted or deformed so that it has the configuration shown at 21' in FIGS. 2, 4, 5, 10 and 11. Its configuration as shown in FIG. 1 is also shown in FIGS. 8 and 9.

As shown in FIG. 2, the end of straw 20 which is most remote from piston member 21' is heat sealed as indicated at 26. Preferably the heat sealing is carried out in such manner that a displaced portion of the wall of straw 20 indicated at 27 is brought into contact with an undisplaced portion of the wall of straw 20 indicated at 28 and the displaced portion 27 is heat sealed at 29 to undisplaced portion 28 to provide heat sealed closure 26.

Straw 20 is preferably made of plastic, that is, polymeric synthetic resinous material. Suitable materials include polystyrene, high density polyethylene, polypropylene and ABS. The material of the straw is preferably relatively rigid, the term relatively in this instance being used with respect to the rigidity of piston member 21. Thus, as an example only, a suitable polymeric material for the tube of straw 20 may have a Rockwell hardness on the M scale of 19 and on the R scale of 105 and may have a flexural strength of 9,300 psi determined by A. S. T. M. method D-790 and an elongation of 130%. These values are merely illustrative since for example a straw might have a tensile strength as low as 5,000 psi or as high as 100,000 psi and be quite suitable.

A suitable material for piston 21 is a "thermoplastic rubber" obtained by copolymerizing styrene and isoprene often referred to as Buna S rubber. Any one of a large number of synthetic rubbers including silicones may suitably be used and it is possible that a natural rubber might possibly be used if it retains its resiliency at liquid nitrogen temperatures. In an exemplary instance, a piston is suitable if it has a Shore durometer

on the A scale of 45 and a tensile strength of 600 to 700 psi. Durometers within the range of 20 to 60 may be suitable, it being merely critical to the invention that the piston be made of resilient and elastomeric polymeric material which retains its effectiveness at liquid nitrogen pressures and which together with the material of the straw and the wall thickness of the straw and the diameter of the piston meet the requirement that when the piston member is inserted within the straw the piston member is appreciably deformed and the straw is substantially not deformed at all. Conceivably the straw may expand outward slightly somewhat in the area in which the piston is received therewithin, such slight amount being for example on the order of 1/10 of 1/1000 of an inch but in actual fact no deformation of the straw has been measurable. The deformation of the piston member when inserted in the straw should be appreciable if not considerable and for this purpose it has been found suitable to make this piston member with a diameter of on the order of 0.005 to 0.015 of an inch greater than the internal diameter of the straw. The dimensions of the straw for the purposes of the present invention are not substantially critical. Thus it might be on the order of 2 to 4 millimeters in diameter, 4 to 7 centimeters in length and may have a wall thickness of 0.005 to 0.010 of an inch, though for other purposes a length of 5 to 6 centimeters and a diameter of about 3 centimeters are preferable and a wall thickness on the order of about 0.007 inch has been found suitable.

The ends of piston member as shown in 21' extend curvedly arcuately convexedly outwardly, protruding as indicated at 22. The ends as shown at 22 may be referred to as convex or extending convexedly. The terms convex and convexedly as used hereinafter in the description and the claims are to be understood to refer to such arcuately curvedly convexedly outwardly extending ends.

As shown in FIG. 4, sealed closure end 26 may be severed and removed as indicated at 26' from straw 20 suitable cutting members 30 pushed together as indicated by arrows 31. The remaining portion of the straw may be referred to as an open-ended straw and may be inserted as indicated at 20' into sheath tube 32. Sheath tube 32 is a tubular member having gradual reduction in its internal lateral dimension near one end as indicated at 33 and terminating in a terminal orifice 34 which is smaller in lateral dimension than the internal lateral dimension of the sheath tube as indicated at 35 and smaller than the internal diameter of the straw. The open end of the straw 20' may be received against the internal surface of the converging walls 33 of sheath tube 32 as indicated at 36 and the contents of the straw may exude as indicated at 37. Sheath tube 32 may be provided with an outwardly extending or protruding portion or flange 38 at the end opposite terminal orifice 34. A push rod or pusher member 40, which may have a convex end at 41 and a widened portion or head at 42 may then be inserted in sheath tube 32 and in straw 20' so that end 41 is adjacent piston member 21'.

As shown in FIGS. 6, 12 and 13, pusher member 40 may be forced by the operator in the direction indicated by arrow 43 for example by engaging flange 38 with fingers and head 42 with the thumb. The convex end 41 of pusher member 40 engages one end of piston member 21' and forces said end at 41' into a concave shape conforming to the convex shape of end 41 and

the convexness of end 22' may then be greater than the convexness of ends 22, the piston member in this configuration being indicated as 21''. The contents of straw 20' are thus forced outwardly through terminal orifice 34 as indicated at 45.

As shown in FIGS. 7 and 14, pusher member or push rod 40 may be operated as indicated by arrow 43 until piston member 20 is partially extruded through terminal orifice 34 as indicated at 21'', to remove from the interiors of straw 20' and sheath tube 32 a maximum amount of liquid 25.

In FIG. 15 there is shown a modification of pusher member 40 or push rod 40 wherein a major portion is made sinuous as shown at 40'. When it is inserted in a sheath tube member 32 as shown in FIG. 16 the sinuosity is reduced and peaks of waves of rod 40' contact the interior wall of sheath tube 32 at the points indicated as 50. Head 42' may have a different configuration than shown at 42 in FIGS. 5, 6 and 7.

When tube 32 is held vertically, with orifice 34 uppermost, the frictional engagement of rod 40' with the interior walls of sheath tube 32 at points 50 prevents rod 40' from dropping downwardly and out of tube 32.

Sheath tube 32 and pusher 40 are preferably made of plastic such as polypropylene or high density polyethylene.

It will be apparent to those skilled in the art that equivalents may be utilized.

Accordingly, the present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and accordingly, reference should be made to the appended claims rather than to the foregoing specification as indicating the scope of the invention.

It is claimed:

1. A straw assembly for the artificial insemination of animals, said straw assembly comprising the combination of:

a straw consisting of a tubular member of polymeric synthetic resinous material,
said polymeric synthetic resinous material being heat sealable,
said straw filled with semen-containing fluid,
said straw heat sealed at one end to provide a heat sealed closure,
said heat sealed closure being sealed to withstand internal liquid pressure applied thereto by the liquid within the straw of 50 pounds per square inch,
said polymeric synthetic resinous material being relatively rigid,
said walls being of sufficient thickness and said polymeric synthetic resinous material of sufficient rigidity so that said straw withstands an internal liquid pressure of 50 psi without leakage,
a piston member received in said straw,
said piston member disposed toward the opposite end of the straw from said heat sealed closure,
said piston member being substantially spherical when not received in said straw,
said piston member being of polymeric elastomeric material,
said piston member being relatively resilient with respect to the rigidity of said walls of said straw,
said piston member deformed as received in said straw into a substantially cylindrical member having convexedly extending ends,

said piston member disposed to exert at least 50 pounds per square inch pressure on the contents of said straw when urged inwardly into said straw with a pusher member, without leakage of said contents past said piston member.

2. The device of claim 1 wherein said heat sealed closure is characterized by a displaced portion and an undisplaced portion of the wall of said straw, said displaced portion displaced into contact with said undisplaced portion and heat sealed thereto.

3. The device of claim 1 wherein a cross-sectional through said heat sealed closure taken on a plane normal to the axis of said straw is arcuate in form.

4. The device of claim 3 wherein said cross-section is substantially semi-circular in form.

5. The combination of the device of claim 1 with a sheath tube and pusher member wherein:

said sheath tube is a tubular member having its internal and external dimensions gradually reduced at one end to provide a terminal orifice at said end, said orifice having an internal lateral dimension smaller than the internal lateral dimension of said straw,

said sheath tube disposed to receive said straw after removal of said heat sealed closure from said straw to provide an open end of said straw,

said gradually reduced portion of said sheath tube adapted to receive said open end abutted there-

against,

said pusher member having convexedly extending end to be received in said straw with said convexedly extending portion received against said piston member.

6. The device of claim 5 wherein said piston member is deformed by said pusher member to provide said piston member with a shape being that of a cylindrical member disposed in said straw with one end disposed toward the interior of said straw and one end disposed toward the exterior of said straw and in contact with said pusher member, said end disposed toward the interior of said straw convexedly extending toward the interior of said straw and the other end which is in contact with said pusher member being concave and conforming to the convexedly extending end of said pusher member.

7. The article of claim 5 wherein said pusher member is received in said straw with said convexedly extending end of said pusher rod received against said piston member and said piston member extruded by pressure of said pusher member out of said open end of said straw and partially through said orifice of said sheath tube whereby to expel a maximum proportion of the contents of said straw outwardly from said straw and from the end of said sheath tube member adjacent the open end of said straw.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,877,430 Dated April 15, 1975

Inventor(s) Horst K. Wieder

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 40, after "straw 20" insert -- by --;
Column 7, line 11, change "cross-sectional" to -- cross-section --.

Signed and Sealed this

fifth Day of *August* 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks