

[54] **INTRAUTERINE CONTRACEPTIVE DEVICE**

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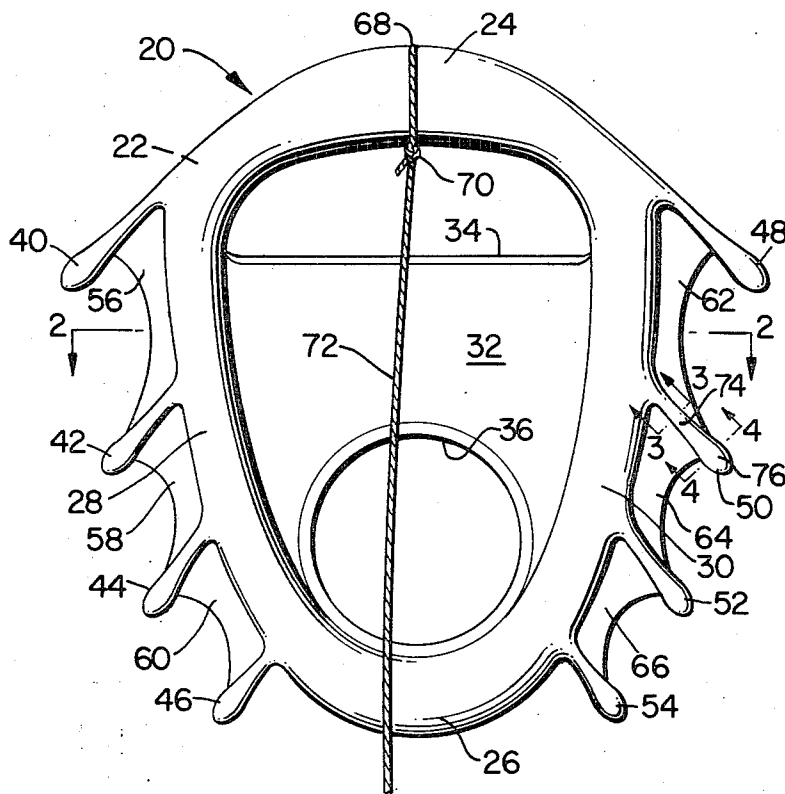
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[57]

ABSTRACT

An intrauterine contraceptive device made from plastic and having a perimetral ring with or without a central membrane and including short retrograde spurs having bulbous contour located on each of the outer side portions of the perimetral ring. The spurs preferably have a retrograde inclination and are of decreasing length from a nose portion of the perimetral ring toward the tail portion, the nose portion being slightly wider than the tail portion providing the IUD with an inverted pear shaped outline when viewed in plan. A marker and extraction string or line is preferably secured at the nose portion but can be secured to the tail portion. Between spurs, thin webs may be utilized to provide increased IUD surface area. The webs may or may not be secured to the spurs and may terminate between or beyond the spurs. Internal of the perimetral ring is preferably a membrane having openings at least adjacent the nose and the tail. The membrane may be secured at both sides or it may be secured by a plurality of intermediate narrow membrane portions spaced around the interior of the perimetral portion.

115 Claims, 12 Drawing Figures



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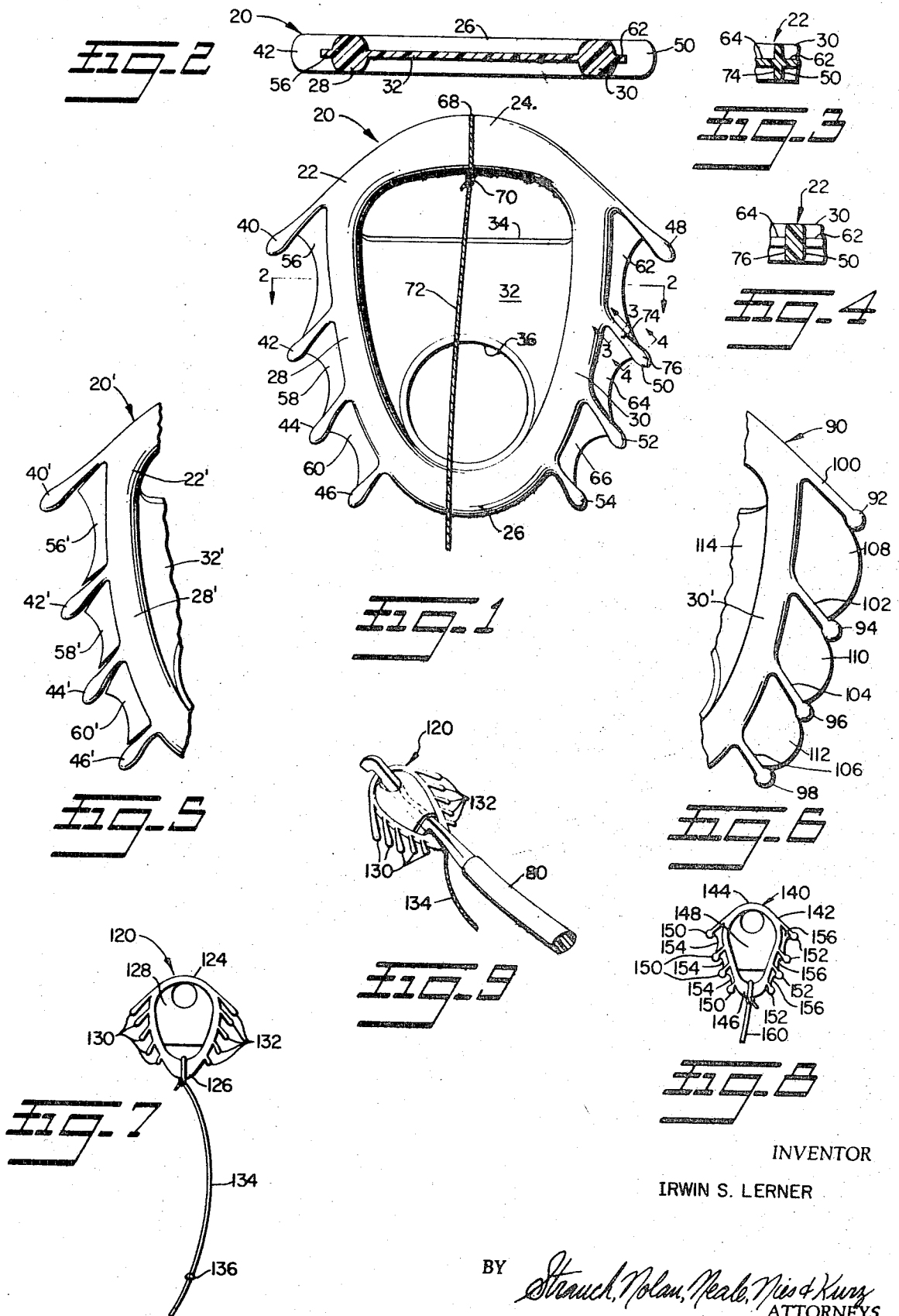


Fig. 10

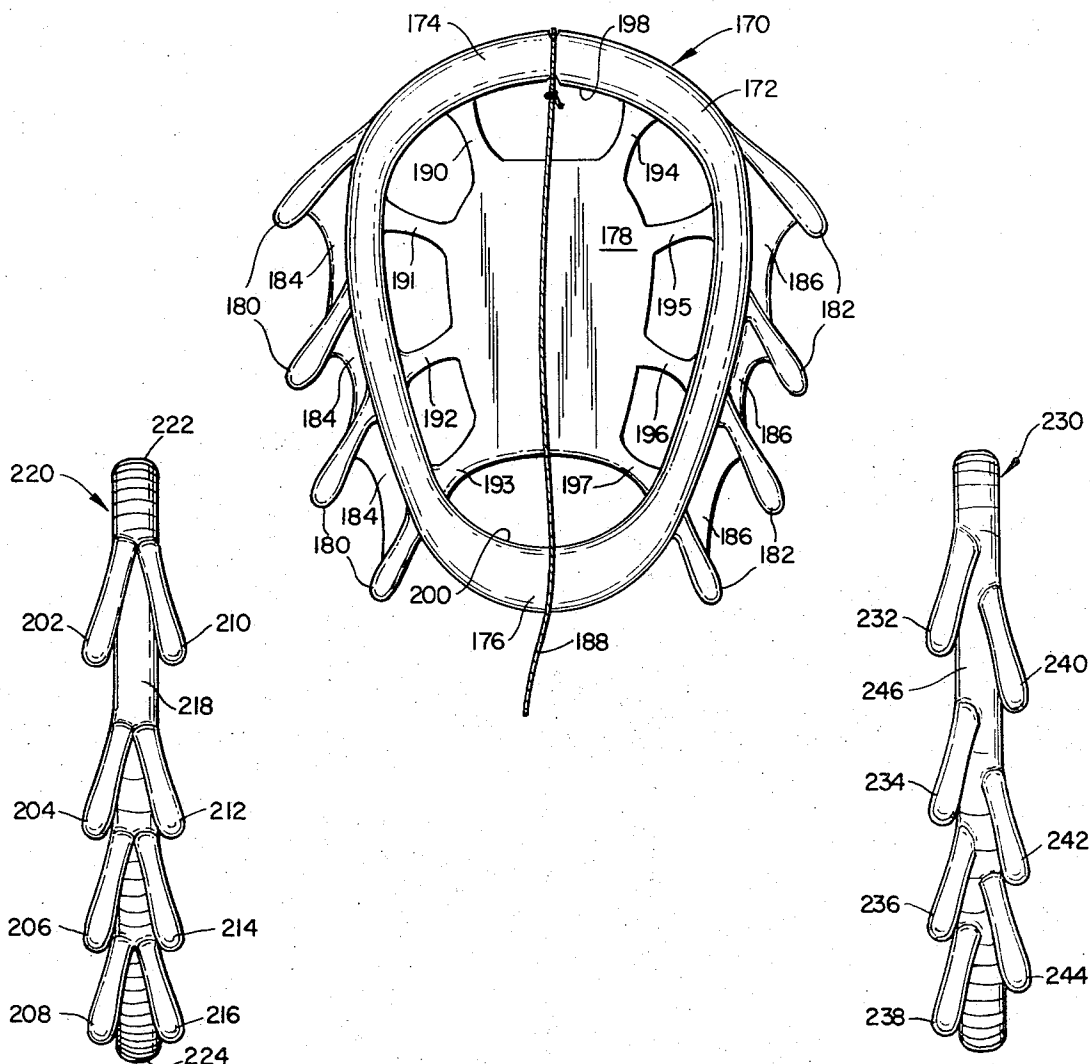


Fig. 11

Fig. 12

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INTRAUTERINE CONTRACEPTIVE DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

This invention pertains to improvements in the IUD which constitutes the subject matter of and is claimed in my copending application Ser. No. 775,729, now U.S. Pat. No. 3,633,574 filed Nov. 14, 1968 for "INTRAUTERINE CONTRACEPTIVE DEVICE."

The IUD's herein disclosed can be inserted by using the inserter disclosed and claimed in my co-pending application Ser. No. 87,663, filed Nov. 9, 1970.

BACKGROUND OF THE INVENTION

The invention relates to contraceptive devices, particularly those designated intrauterine contraceptive devices, hereinafter referred to as IUD's. As was reiterated in the afore-described co-pending application, IUD's have had increased attention toward improving their characteristics in recent years because the population rate is becoming critical throughout many areas of the world. The IUD of the afore-described application introduced a new concept in effective intrauterine contraception, corresponding to the physiologic variations of the normal uterine cavity. Accommodation to variations in cavity shape and physiologic contractions was promoted by the light, flexible design and materials of exceptional resilience. The IUD, as basically taught in the afore-described application, is engineered so that expulsive contractions directed against the broad upper portion results in flaring and flexion at the apex, increasing resistance to expulsion. The high degree of flexibility of the plastic IUD device together with the central membrane and the side spurs are believed to contribute the major force of the effectiveness of applicant's IUD, and those details have been set forth clearly in the afore-described application. The unique central membrane assures increased endometrial surface contact and guards against embedment. The central membrane also guards against intestinal strangulation in the event of perforation as reported with closed loop designs. Those features make the IUD with central body, side spurs and central membrane well tolerated by nulliparous as well as multiparous patients, and result in enhanced use-effectiveness in professional practice. That IUD has an extremely low pregnancy rate, expulsion rate, removal for medical reasons, and personal removals.

Nevertheless, there is constant development under way to improve construction of IUD's in an attempt to obtain the ultimate which is 100 percent effectiveness in comfort, retention and contraception and the improvements of this invention are directed toward such a more effective IUD.

SUMMARY OF THE INVENTION

The present invention involves several improvements, one of which increases the area of the IUD and that is accomplished by one or more of several structural aspects: increasing the number of spurs; making the spurs bulbous; inserting thin webs between the side spurs; and increasing appendages by which the central web is secured to the perimetral portion. In addition to the foregoing it is also proposed that rather than have the spurs extend in the same horizontal planar configuration of the perimetral portion, the spurs may be inclined, i.e., extend upward or downward relative to the

planar area. Furthermore, the external perimeter of the rim may be provided with two or more rows of fins which would enable better retention within the uterus. The tissue of the uterine cavity can enfold and "grow" around the spurs, in essence grabbing and firmly locating the IUD within the uterine cavity.

In addition to the foregoing improvements, the marker or telltale string or line can be secured to the nose as an alternative to being attached to the tail end of the IUD. In such case, if removal is indicated, steady traction on the telltale line causes the IUD to invert and permit a nose first withdrawal, whereby passage through the cervical canal is facilitated because the fins, which have a retrograde inclination, will collapse in the manner for which they were designed for ease of introduction into the uterus.

Accordingly, a primary object of this invention resides in an improved intrauterine contraceptive device. In this regard the improvements include provision of larger IUD surface areas for greater endometrial surface contact including, as desired, more spurs, webs between spurs and even extending beyond the ends of the spurs, enlarged portions of the spurs, and relocation of the telltale or marker string to an attachment point at the nose of the IUD to invert the IUD for removal with the nose end first.

It is also an object to provide an improved IUD having all the benefits of the unique IUD set forth in copending application Ser. No. 775,729. As with that IUD, the IUD of this invention readily accommodates itself to various uterus sizes; resists expulsion through the cervical os; is easy to insert; and its shape and central membrane prevents possibilities of strangulation which can occur if an open type device should protrude or escape into the peritoneal cavity.

Another object resides in the provision of an improved IUD which includes a central body with a perimetral portion having a nose, tail and side portions with a plurality of short spurs extending outwardly from each of the side portions, the improvements consisting of improved IUD surface are configurations which can be one or any combination of: enlarged terminal parts of the spurs; increased numbers of spurs, as by providing more than one row of spurs on each side portions and varying the relative locations of the spurs in the plural rows; adding thin webs between spurs, either connected to or disconnected from the adjacent spurs and even extending beyond the ends of the spurs; and modifying a central web to make it more flexible by securing it to an inner perimeter of the perimetral portion by a plurality of spaced apart thin integral membrane portions. Enlarged terminal end portions of the spurs can be provided by gradually increasing the spur width from a narrow waisted inner part joined to the perimetral portion, to the projected end of the spur thereby providing a bulbous spur. Alternatively, the spurs can terminate in small spherical knobs or the like.

A still further object resides in the provision of an improved IUD which includes a central body with a perimetral portion having nose, tail and side portions with a plurality of short spurs extending outwardly from each of the side portions, the improvement being attachment of a tell-tale or marker location string at the nose portion of the IUD in order that, when removal is desired for any reason, the IUD can be inverted within the uterus and then extracted nose first by pulling on the string.

Other objects reside in providing an IUD in accord with any of the foregoing objects made from a light flexible plastic such as "ULTRATHENE," polyethylene, polypropylene, ethylene, propylene, and other suitable plastic materials. In this conjunction the IUD's can, if desired, be treated by adding other materials in the form of powders molded with the plastic or coatings to enhance the ability to locate the IUD when placed and to enhance contraceptive effectiveness.

Further novel features and other objects of this invention will become apparent from the following detailed description, discussion and the appended claims taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

Various structural embodiments of this invention are disclosed in the accompanying drawings, in which:

FIG. 1 is an enlarged plan view of one embodiment of an IUD made in accord with the present invention showing both the bulbous spurs and webs between and interconnecting the spurs;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1 and shows the central membrane and webs between the spurs;

FIG. 3 is a transverse section taken on line 3—3 of FIG. 1 illustrating the narrow waist portion of a bulbous spur;

FIG. 4 is a transverse section taken on line 4—4 of FIG. 1 illustrating the wider dimension near the terminal end of a bulbous spur;

FIG. 5 is a partial, enlarged plan view of one side of an IUD embodiment similar to the device shown in FIG. 1 but modified in that the webs between spurs are not connected to the spurs;

FIG. 6 is a partial, enlarged plan view of a further IUD embodiment like the device shown in FIG. 1 but modified in that the spurs terminate as small spherical knobs and the webs between spurs are increased in size to provide additional endometrial surface contact;

FIG. 7 is a small scale plan view of a further embodiment of an IUD having bulbous spurs without webs between the spurs;

FIG. 8 is a small scale plan view of still another embodiment of an IUD with spurs terminating in knobs and webs between spurs as shown in FIG. 1. This embodiment has a more narrow overall plan configuration than the device shown in FIG. 7, being particularly suited for nulliporous application;

FIG. 9 is a perspective view drawn to the same small scale as is FIG. 7 and illustrates that IUD embodiment retained on the end of a specially shaped stick inserter ready for insertion;

FIG. 10 is an enlarged plan view of still another modification of the IUD of this invention similar to the device of FIG. 1 but modified in that the central membrane is suspended by a plurality of narrow membrane bridges attached to the sides of the perimetral rim;

FIG. 11 is an enlarged side view of still another embodiment of an IUD in accord with this invention modified in that a double row of spurs are included on each side of the IUD perimetral rim; and

FIG. 12 is an enlarged side view of yet another embodiment of an IUD having two rows of spurs on each side of the IUD perimetral rim as in the device of FIG. 11 but with the spurs in one row offset from the spurs of the adjacent row of spurs.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Each of FIGS. 1, 5, 6, 7, 8, 10, 11 and 12 in one or more respects illustrate different features of the present invention. Many of such features from one of those Figures can be interchanged or used in conjunction with the features of other Figures, but for convenience of keeping the drawings within reason all such possible combinations of features have not been illustrated. For example, projected webs can be used with any kind or arrangement of adjacent spurs, single row or plural rows, and the web may or may not be connected to the adjacent spurs.

Turning first to FIG. 1, an IUD 20 is shown which consists of a perimetral ring 22, somewhat elongated and having a plan view like an inverted pear shape. The wider end of IUD 20 is the nose 24 and the smaller end is the tail 26 and the nose and tail are joined by two side portions 28 and 30. A thin membrane 32 is disposed across the major central area within the inner perimeter of the ring 22 and, as shown, is attached essentially along the inner edge of the two side portions 28 and 30 to provide a first aperture 34 adjacent the nose end 24 and a second aperture 36 adjacent the tail end 26. Either or both of apertures 34 and 36 can be circular, as is 36, or non-circular, as is 34. A plurality of short spurs 40, 42, 44 and 46 extend outwardly from ring side portion 28 and complementary spurs 48, 50, 52 and 54 extend outwardly from the opposite side portion 30. While four spurs are disclosed, the number of spurs on each side could be a different plurality (see FIG. 7 and FIGS. 11 and 12). Thin scalloped webs 56, 58 and 62 are secured to the ring side portion 28 between and attached to adjacent ones of spurs 40—46 and complementary webs 62, 64 and 66 are secured to the opposite ring side portion 30 between and attached to adjacent ones of spurs 48—54. Centrally located on the nose 24 are small retention grooves 68 and 70 which enable a marker line or telltale string 72 to be tied at the apex of the nose.

Although it is not necessary, it is preferred that the membrane 32 be discontinuous to provide the nose and tail apertures 34 and 36 to enable an efficient insertion with a stick type inserter 80 (FIG. 9), described structurally and functional in the afore-described co-pending inserter application. Other types of inserters may be used, in which case one or both of the membrane apertures may be eliminated. Alternatively the membrane can be eliminated or made in other configurations, such as that which will be described hereinafter for FIG. 10.

The perimetral ring 22 provides the structural frame work of device 20, and its pear shape functions to maximize the likelihood that the IUD 20 will be retained in place after insertion in the uterus. Specifically, the ring 22 is designed to make the device flexible enough so that it yields when placed in hoop compression by the natural muscular activity of the uterus. If the device resisted such pressures unyieldingly, it might be moved in the direction of the cervical os, act as a dilating wedge, and eventually be expelled.

The cross-section of the perimetral ring portion 22 is substantially rectangular with rounded corners throughout the perimeter of the ring, but in either or both of the nose and tail regions the ring thickness is normally made greater in the direction parallel to the

plane of the ring than it is in the direction perpendicular to that plane.

The general cross-section of the ring has a thickness dimension of approximately 1.5 mm. perpendicular to the plane and parallel to that plane, although it may be increased, e.g., to approximately 3.0 mm., in both dimensions at either or both of the nose or tail portions. This enables a slightly stronger rim portion where the marker string is attached and also when the ring 22 is subjected to hoop compression applied to the sides by the adjacent uterine walls, it will buckle first in the side regions.

One advantage of this function is that the intrauterine device 20 tends to deform in response to such compression, rather than to be cammed longitudinally relative to the uterine wall. If the ring 22 buckled first at the nose region 24, it would be subject to a camming force tending to move it toward the cervical os, with expulsion as a possible consequence. Thus the tendency of the ring 22 to first buckle in the side regions 28 and 30 helps to prevent expulsion. A second advantage resulting from such side buckling has to do with deformation of the central membrane 32 as is discussed below. The device 20 does not suffer from the disadvantage of the "long-line" type of intrauterine devices which are so flexible that one can be deformed by uterine contractions into a linear shape and thus expelled through the cervical os by a reversal of the insertion process.

However, while the ring shape and size result in response to external forces on the perimeter by deforming the entire device in a non-planar manner, the addition of the membrane 32 also enables the desired deformation whether the ring cross-section is rectangular or round or made with almost any geometric shape. When the device 20 with a central membrane 32 is subjected to external forces around its perimeter, the spurs 40-54 deflect initially in response to these forces and then transmit these forces to the ring 22. As the ring tends to collapse, portions of the membrane 32 respond to the compressional forces by becoming non-planar and other portions of the membrane have a resultant force in tension causing the ring to deflect in a non-planar manner in the region where the membrane in tension is attached to the ring. Side forces on the device cause non-planar deformation of the device, and, in particular, will cause the tail region to deflect out of the planar configuration and away from the cervical exit through the os.

Ring 22 has overall dimensions which are designed to correspond to the midrange of average uterine sizes, the uterus being in normal condition, while at the same time making sufficiently firm contact with the wall surfaces of any size uterus to be firmly retained in place. Specifically, ring 22 is of a generally elliptical (pear-shaped) configuration in that the outside dimension of the ring along the nose-to-tail axis is greater than the maximum outside dimension along an axis transverse thereto. The preferred outside dimension of the ring 22 along the nose-to-tail or major axis is approximately 21 mm., and a preferred range of major axis outside diameters is from 19 to 31 mm. The preferred maximum dimension of the ring 22 in a direction transverse to the major axis is 16 mm., although a preferred range of outside diameter is from 12 mm. to 27 mm. The maximum transverse width of the ring 22 is reached at a location closer to the nose end of the device, region 24, than to the tail end, region 26. This is related to the fact that

the curvature of the ring 22 at the nose of the device is more blunt, compared to the ring curvature at the tail end which is more pointed. The resulting trilobite, or buglike shape of the ring further increases the tendency of the device 20 to resist being expelled tailward through the cervical os, since, apart from any considerations of buckling, an object under sideways compression tends to be cammed toward its wider end, in this case the nose region 24.

The outside dimensions referred to so far in this detailed description have to do with the dimensions of the ring 22 alone. The lateral dimensions of the entire intrauterine contraceptive device 22, including the spurs, are greater than those previously noted. In the embodiment of FIG. 1, there are four such spurs 40-54 on each side of the ring 22. The longest ones 40 and 48 are located nearest to the nose end of the device, and the spurs decrease progressively in length as they approach the tail end. Moreover, while the spurs may do so they preferably do not extend outwardly from the ring in a radial direction from the ring but have a retrograde inclination, in other words, they slant toward the tail end of the device 20 so as to form an acute angle (from 90° to 15°) with the major axis of the ring. The value of that angle preferably decreases progressively from the foremost spurs 40 and 48 through the rearmost 46 and 54. While it is preferred that the spurs extend outwardly from the perimeter of ring 22 along the general plane for which the ring is situated, this is not necessary. The spurs may extend away from ring 22 at angles to the general plane of the ring.

The foremost spurs 40 and 48 are preferably about 5.1 mm. long, measured from the outermost tip of the spur to the point at the base of the spur where its longitudinal axis intersects the extrapolated surface of the ring 22. An approximate range for this dimension is from about 2.5 mm. to 9.0 mm. The forwardmost spurs 40 and 48 are swept back at preferred angles of about 50° to the major axis of device 20.

The fourth set of spurs 46 and 54, those closest to the tail end, have preferred lengths of about 2.5 mm. A range of about 1.2 mm. to 3.7 mm. is preferred although other lengths outside of this range are useful. Spurs 46 and 54 are swept back at preferred angles of about 30° to the major axis.

The intermediate second spurs 42 and 50 and third spurs 44 and 52 have lengths and inclined angles intermediate those described for the first set and fourth set of spurs.

All of the dimensions above and hereafter set forth are merely preferred dimensions and ranges. IUD's with the preferred dimensions have seen actual use and have been eminently satisfactory. However, wide variations in any given dimension and in relative dimensions, even beyond the limits of the preferred ranges, may be employed, and more over the described relative lengths of spurs 40-46 and 48 through 54, while preferred, are not critical and the forward spurs can even be longer than those located further to the rear than the differences between the aforescribed front and rear spur dimensions.

The spurs serve a number of functions. They flex to a disposition closer to the ring 22 in response to the natural muscular contractions of the uterus, and thus help the overall device 20 to yield to such contractions rather than resisting which would increase the chances of expulsion through the cervical os. The flexibility of

these spurs also permits the device 20 to fit a greater range of uterine sizes, since the spurs can either remain spread out to contact a larger uterine cavity or can flex inwardly to accommodate a smaller one, while still helping to retain the device 20 in place.

Additionally, because the spurs are resilient cantilevers, particularly in a direction along the general planar configuration of the ring, they will yield to muscular contractions transverse to their length and by so yielding, apply a self-restoring force against the uterine wall to maintain the device in its proper position.

Most significantly, however, the spurs have a preferential retrograde direction of slant towards the tail end of the device 20 which serves to impede retrograde movement of the device 20 in the direction of the cervical os. The device is inserted nose end first; i.e., the region 24 enters the uterus first, followed by the intermediate parts and then the tail region 26. As a result, reverse movement of device 20 goes against the "grain" (slant) of the spurs. In order to move in the reverse direction the spurs would have to be flexed outwardly from the ring 22, which increases their spread and hence is not easily accomplished. By resisting such deformation the spurs impede reverse movement of the device. In contrast, upon initial insertion of the device the spurs are more easily flexed rearwardly, i.e., bent in closer to the ring 22, so that they offer considerably less resistance to movement in the direction of insertion.

FIGS. 3 and 4 are transverse sections taken respectively through the waist 14 and a location near the bulbous terminal end 76 of a typical spur 50. The two sections illustrate that the bulbous terminal portions 76 of the spurs are larger than the waist portions 74 and that the spurs are thicker in the direction perpendicular to the plane of the ring 22 than they are in the direction parallel to the plane. For convenience this shape may be termed tear drop inasmuch as it has an elongated teardrop profile in plan view. As a result of this difference in the thickness in the two directions and the substantially less thickness at the waist of the spurs, the spurs flex readily toward the ring 22, while it is relatively more difficult to deflect them out of the plane of the ring 22. Thus the spurs can easily yield during initial insertion of the device 20, but it is undesirable that they be deflected too far out of the plane of the ring since that would make them less effective in impeding reverse movement of the device.

In this teardrop embodiment of bulbous spurs, the cross-section of the spurs gradually increases from the narrow waist portion 74 as the terminal end is approached. Such bulbous spurs have larger areas than straight narrow spurs yet the desired flexibility of spurs in a direction parallel to the plane of the ring is retained because of the narrow waist while the bulbous shape of the spurs provides an increased IUD surface area for contacting the uterus.

The thin walled scalloped webs 56-60 and 62-66 between adjacent spurs on opposite sides of the perimetral ring 22 serve primarily to provide additional IUD surface area. Such webs are in the plane of membrane 32 and may be disposed wholly between and integral with the spurs, as depicted in FIG. 1 or, as shown at 56', 58' and 60' in FIG. 5, the webs may be disposed loose from the spurs 40', 42', 44' and 46' and integral only with the side portion 28' of ring 22'. If the webs are integral with the spurs it decreases the flexure of the

spurs which may be desirable in smaller sizes of IUD's for nulliparous patients (see FIG. 8), and if loose from the spurs, enables substantial flexibility of the IUD for more patient comfort.

In any event the increased size of the bulbous spurs and the added areas afforded by the webs, whether joined to the spurs or not, assures increased endometrial surface engagement which enhances contraceptive effectiveness. The webs provide such function with relatively large areas of surface which helps prevent embedding of the device yet the open areas around the spurs permit enfolding of such appendages by the uterus tissues to help locate and maintain location of the IUD once it is properly placed within the uterus.

Referring back to the membrane 32, one of its functions is to block the interior of ring 22 so as to prevent intrusion of intestinal tissue thereto in the event the device 20 should be partially or completely perforated into the peritoneal cavity. Moreover, the membrane 32 is thin enough to be very flexible, the preferred thickness being only about .15 mm., and the preferred range of thickness being from about .05 mm. to 1.5 mm. Because of such flexibility, when the ring 22 is under hoop compression by uterine muscles, the membrane has a tendency to buckle out of the plane of the ring 22 and consequently to bear against the internal wall of the uterus. This additional contact against the uterine wall is a further factor in resisting expulsion of the IUD 20 when muscular contractions take place.

In order to enable the membrane 32 to buckle more easily in this manner, it is detached from the ring 22 preferably at at least two locations 34 and 36 adjacent to the nose region 24 and tail region 26 respectively. Freeing the membrane 32 from the ring 22 at these locations increases the likelihood that it will buckle along a line roughly corresponding to the major axis of the device.

Relieving of membrane 32 at locations 24 and 26 is preferably amplified to the extent of providing the two distinct openings 24 and 26, previously mentioned as among the general features of the IUD 20. The nose opening 24 is useful for cooperation with certain types of uterine insertion devices, while tail opening 26 is useful for cooperation with an extracting hook. Some inserters do not require openings. However, as has been herein described, the nose and tail openings are utilized with the special inserter 80 (FIG. 9) described in the aforescribed co-pending inserter application.

From the nose or tail end of the device the telltale string 72 will extend out through the cervical os so that the presence of the IUD can be verified by vaginal examination. The telltale string 72 may be tied around or otherwise secured to the ring 22 at the nose 24 or tail 26. For example, as an alternative to tying the string, a small hole (not shown) may be provided for the purpose of inserting and securing string 72, or the string may be secured by molding it integral with the remainder of device 20 to thereby eliminate the connection problem and costs incurred therewith.

IUD (FIG. 5)

The IUD 20' shown in FIG. 5 is substantially like the IUD 20 described in connection with FIG. 1, the difference being depicted is that the webs, i.e., 56', 58' and 60' between adjacent spurs, i.e., 40', 42', 44' and 46' are separated, as by cutting after molding, from the spurs to permit the spurs to flex without restraint by

web interconnection yet the webs will still provide the desired increased endometrial surface contact. The use of webs loose from the spurs but attached to the ring side portions can be used with any of the embodiments of IUD's illustrated in FIGS. 1, 6, 7, 8, 10, 11 and 12.

IUD (FIG. 6)

The novel aspects of the IUD 90 shown in FIG. 6 are the provision of small sphere-like knobs 92, 94, 96, 98 as the enlarged terminal end portions of bulbous spurs 100, 102, 104 and 106 and large size, thin walled webs 108, 110 and 112 secured to the perimetral ring side portion 30', and extended from between each of the adjacent ones of spurs 92, 94, 96 and 98 to protrude beyond the ends of the spurs. While in this embodiment it is preferred that the webs be secured only to the side portion 30' of IUD 90, as shown in FIG. 5, they can be secured to the spurs as is shown in FIG. 6 to provide stiffness for the spurs.

The cross sectional shape of spurs 100-106 is rectangular and disposed with the long side of the section normal to the general plane of the IUD 90 similar to the section shown in FIG. 3. That shape provides flexure of the spurs in a direction parallel to the general plane of the IUD and tends to resist flexure of the spur normal to the general plane of the IUD. Otherwise the IUD 90 is similar in shape and function to the IUD 20 of FIG. 1.

The large protruding webs are preferably located at the mid-plane of the perimetral ring in the same plane in which the membrane 114 is located, but they could be offset if desired. The protruding webs 108-112 and knobs 92-98 on the spurs assure a substantial increase in endometrial surface contact and hence increase the contraceptive effectiveness of the IUD. Such protruding webs and the bulbous knob-like ends on the spurs can be utilized together or independently on any of the embodiments disclosed herein.

IUD (FIG. 7)

The IUD 120 illustrated in FIG. 7 and also in FIG. 9 is illustrative of a commercial embodiment currently in use. It includes the perimetral ring 122 with nose 124, tail 126, central membrane 128 and bulbous spurs 130 and 132 of gradually increasing size. It does not include webs between the spurs although any features as are shown in the other embodiments could be used with IUD 120. In this instance, the marker line or telltale string 134 is secured to the tail portion. Knot 136 is located 7 cm. from the nose of the IUD to provide a surgical indication that the nose of the IUD is properly placed in the high fundal position within the uterus.

FIG. 9 illustrates the exemplary IUD 120 carried on an inserter 80 which is constructed and intended to be used in accord with the invention disclosed and claimed in the aforescribed co-pending inserter application wherein an insertion technique applicable to the IUD's herein described is fully disclosed.

IUD (FIG. 8)

FIG. 8 is a representation of another commercial embodiment of an IUD 140 currently in use and incorporating features of the present invention. IUD 140 is smaller than the IUD shown in FIG. 7, being specifically intended for use as a nulliparous size. IUD 140 includes the features of a perimetral ring 142 with nose 144 and tail 146, a central membrane 148 and bulbous

spurs 150 and 152 with webs 154 and 156 between adjacent ones of the spurs on each side. The bulbous spurs in this case are the kind shown in FIG. 6, the spurs terminating in essentially spherical knob-like ends 158. As in the IUD 120 of FIG. 7, a marker string 160 is secured to the tail end portion 146. Additional or alternate features as are shown in the other embodiments could be used with an IUD shaped generally like IUD 140.

Both of the drawing FIGS. 7 and 8 are scale drawings of the actual IUD's available in the medical field. The maximum exterior dimension from nose to tail in both of the IUD's 120 and 140 is approximately 21 mm. The lateral dimension between the ends of the upper spurs is approximately 24 mm. for IUD 120 and 20 mm. for IUD 140. These dimensions are not considered limiting but are given to provide a disclosure of relative sizes of multiparous and nulliparous IUD's. Both of IUD's 120 and 140 include the openings in the membrane adjacent the nose and tail to enable use of the stick type inserter 80 shown in FIG. 9.

IUD (FIG. 10)

FIG. 10 depicts still another embodiment of an IUD 170 made in accord with teachings of the present invention. IUD 170 is similar to IUD 20 shown in FIG. 1 excepting that the central membrane 178 is suspended from the perimetral ring 172 in a different manner. As with IUD 20, the IUD 170 has a perimetral ring 172 with nose 174 and tail 176, and bulbous spurs 180 and 182 with scalloped, thin wall webs 184 and 186 secured to the spurs and to the outer perimeter of ring 172 between adjacent ones of the spurs on each side of the ring. The bulbous spurs 180 and 182, as shown, are the kind as shown in FIG. 1 having a gradually increasing transverse cross-section area in a direction approaching the end of the spurs. In this embodiment, a marker string 188 is secured to the nose portion 174 of ring 172 for use in inverting the IUD when removal is desired.

In IUD 170, central membrane 178 is suspended by narrow membrane strips or bridges 190-197 at spaced intervals around and secured to the inner perimeter of ring 172. They can be secured at locations lying in the common mid-plane of ring 172 or in any other common plane across the ring 172 or the bridges need not lay in a common plane. The IUD 170 with its membrane 178 and the membrane bridges 190-197 as well as the spurs and webs are preferably molded as a single integral unit from plastic. To retain membrane surface area, rather than remove the membrane portion between the bridges, such portions can remain as flaps attached only to the perimeter ring.

The two forwardmost membrane bridges 190 and 194 together with an edge portion of the central membrane 178 and the IUD nose portion 174 define an aperture 198 between the central membrane body and the nose 174 and the two rearwardmost membrane bridges 193 and 197 together with another edge portion of the central membrane 178 and the tail portion 176 define an aperture 200 adjacent the tail portion of the IUD. The two apertures 198 and 200 correspond to apertures 34 and 36 of the IUD 20 (FIG. 1) and are so disposed to enable use of the special stick type inserter 80. If insertion stick by other means, the membrane bridges need not be spaced in a manner to provide the nose and tail apertures. Moreover, while eight mem-

brane bridges are shown in FIG. 10 the number can be more or less than eight.

When the central membrane 178 is made as shown in FIG. 10, suspended by narrow thin wall membrane bridges 190-197, the inner membrane body has additional flexibility which can assure disposition to provide maximum endometrial surface contact. Moreover, the opposed endometrial surfaces of the membrane can engage through the openings between the membrane bridges so the body tissue can grab or enfold the bridges to assure maintaining the IUD in proper location.

The suspended form of membrane 178 can be used with any embodiment of flexible ring type IUD including those herein described.

PLURAL ROWS OF SPURS

The various IUD embodiments which have been hereinbefore described with reference to FIGS. 1-10 have been depicted with a single parallel row of spurs extending from each of the side portions of the perimetral ring with all spurs in a row laying in a common planar configuration with the perimetral ring. The spurs need not be formed to lay in a common plane, inasmuch as the spurs could be placed in plural rows or some of the spurs could be slanted in one or the other direction out of the planar ring configuration. Preferably, if the spurs are slanted out of the planar configuration which includes the ring, some should slant in one direction and some should slant in the other direction somewhat like the offset spurs in the double row of spurs shown in FIG. 12, and spurs will be directed essentially equal in number into primary contact with opposite inner wall surfaces of the uterine cavity to enhance the IUD retention effect caused by the spurs engaging and being enfolded by the uterus wall tissue.

FIG. 11 illustrates one way in which two rows of spurs 202, 204, 206, 208, 210, 212, 214 and 216 can be disposed on a side portion of a perimetral member 218 of an IUD 220. The outer perimeter of the member 218 can be shaped in plan view with a pear shape similar to the outer perimeter of any of the previously described IUD's or it may be round, oval or other closed perimeter figure such as rounded corner rectangular shape. Seen in plan view the spurs could have lengths, inclinations and bulbous shapes similar to those shown in FIGS. 1, 5, 6, 7, 8 or 10 with or without webs located between the spurs. In FIG. 11 the spurs in the two rows are located side by side considering a direction normal to the planar configuration of the perimetral member. Each pair of spurs, e.g., spurs 202 and 210 are slanted in retrograde inclination at the same angle from the nose 222 toward the tail end 224, however each spur of a pair of spurs could be provided with a different angle of retrograde inclination which would result in an effective offset relationship enabling both spurs of a pair of spurs to be engaged by both of the opposite wall endometrial surfaces in the uterus. The spurs 202-216 are shown as having an elongated teardrop bulbous shape but they could be made with a substantially constant cross-section from waist to terminal end. In any case, it is preferred that the longest dimension of the transverse cross-section shape of the spurs be in a direction normal to the planar configuration of the IUD, to enhance flexure of the spurs in a direction along the planar configuration including the IUD perimetral portion.

FIG. 12 illustrates two rows of offset spurs 232, 234, 236, 238, 240, 242 and 244 on one side portion 246 of an IUD 230, which, as was described relative to FIG. 11, could be any of a number of IUD configurations. Again, as has been hereinbefore described relative to FIGS. 1, 5 and 6, webs could be included between any adjacent spurs, within a row or between spurs in two rows.

Spurs 232, 234, 236 and 238 slant in one direction out from the planar configuration of the IUD perimetral portion 246 while the other row of spurs 240, 242 and 244, which are offset to locations between spurs 232, 234, 236 and 238, slant in the opposite direction. While the attached ends of spurs 232-244 of IUD 230 (FIG. 12) are only half as wide as the thickness of the IUD perimetral side portion 246, it is clearly apparent that each of the spurs in plural rows, when spurs are offset, could have the same cross-section dimensions as described for the spurs 40-54 on IUD 20 (FIG. 1).

As described, each of the IUD embodiments such as 20, 20', 90, 120, 140, 170 and others which can be understood from this disclosure, preferably consist of a single piece of integrally molded plastic material which preferably has been mixed with a suitable amount of radio-opaque material to permit the device to be located by X-ray or fluoroscope techniques if necessary. A preferred plastic material, is "Ultrathene," a copolymer of ethylene, and a vinyl monomer material, catalogue listing UE632 (UE633 is also very satisfactory) of U.S. Industries, with 12 percent by weight of barium sulfate as a radio-opaque ingredient. While the proportions just mentioned are preferred, the range of barium sulfate may be anywhere from 0 to 40 percent. Alternative plastic materials which may be employed are polyethylene, polypropylene, ethylene, propylene, copolymers, and terpolymers, e.g., EPT, polyvinyl acetate, copolymers of vinyl acetate with another ethylenically unsaturated monomer copolymerizable therewith, silicone rubber, polyfluoroethylenes, e.g. Teflon, Kel-F, etc., and the like.

In accordance with one feature of this invention, the molded IUD device may be provided with a thin coating of a suitable material or impregnated with a suitable material in powdered form to inhibit the deposition of calcium upon the IUD after it has been in the uterus for a period of time and to otherwise enhance its effectiveness. Such materials include gold, platinum, silver, copper, zinc, tantalum, as well as alloys and salts of these and other metals. The coating may be vapor-deposited to a preferred thickness of approximately 5×10^{-6} inch. A preferred range of coating thickness is from 2×10^{-6} to 40×10^{-6} inch.

The invention may be embodied in other specific forms without departing from the scope, spirit or essential characteristics thereof. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, the scope and spirit of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are, therefore, intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. An intrauterine contraceptive device comprising: a central body having a perimetral portion with nose, tail and side portions and encompassing an area ap-

proximating that of an average normal condition uterine cavity, and a plurality of short spurs with enlarged bulbous terminal portions extending outwardly from each of said side portions.

2. An intrauterine device as defined in claim 1, wherein the axis of all of said plurality of spurs on each side portion are disposed in a common plane.

3. An intrauterine device as defined in claim 2, wherein at least a portion of said spurs have an inclination toward the tail portion.

4. An intrauterine device as defined in claim 2, wherein all of said spurs have a retrograde inclination toward the tail portion.

5. An intrauterine device as defined in claim 2, wherein the spurs closest to said nose portion are longer than the spurs closest to said tail portion.

6. An intrauterine device as defined in claim 1, wherein pull line means are secured to said intrauterine device to enable removal after insertion.

7. An intrauterine device as defined in claim 6, wherein said pull line means are secured to said nose portion.

8. An intrauterine device as defined in claim 6, wherein said pull line means are secured to said tail portion.

9. An intrauterine device as defined in claim 1, wherein thin webs integral with the outer edge of said perimetral portion are disposed on each side portion between at least two adjacent ones of said short spurs on each of said side portions.

10. An intrauterine device as defined in claim 9, wherein said thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

11. An intrauterine device as defined in claim 9, wherein each of said thin webs between adjacent spurs is attached only to said edge of said perimetral portion and is disposed loose between said adjacent spurs.

12. An intrauterine device as defined in claim 9, wherein each of said thin webs between adjacent spurs is attached to said edge of said perimetral portion and is also secured to said adjacent spurs.

13. An intrauterine device as defined in claim 9, wherein each of said thin webs is shorter than the length of said adjacent spurs.

14. An intrauterine device as defined in claim 9, wherein said thin webs integral with the outer edge protrude outwardly from said perimetral portion a distance greater than the length of said adjacent spurs.

15. An intrauterine device as defined in claim 14, wherein said protruding thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

16. An intrauterine device as defined in claim 14, wherein each of said protruding thin webs between adjacent spurs is attached only to said edge of said perimetral portion and is disposed loose from said adjacent spurs.

17. An intrauterine device as defined in claim 14, wherein each of said protruding thin webs between adjacent spurs is attached to said edge of said perimetral portion and is also secured to said adjacent spurs.

18. An intrauterine device as defined in claim 1, wherein a plurality of rows of short spurs are disposed on each of said side portions.

19. An intrauterine device as defined in claim 18, wherein the spurs in all of said rows on each of said side

portions are side by side in a direction normal to the general planar shape of the device.

20. An intrauterine device as defined in claim 18, wherein the spurs in one of the adjacent rows on each side of said side portions are offset from the spurs in another of said adjacent rows on the same side of said side portion in a direction along the perimetral portion.

21. An intrauterine device as defined in claim 18, wherein at least a portion of said spurs have an inclination toward the tail portion.

22. An intrauterine device as defined in claim 18, wherein all of said spurs have a retrograde inclination toward the tail portion.

23. An intrauterine device as defined in claim 18, wherein the spurs closest to said nose portion are longer than the spurs closest to said tail portion.

24. An intrauterine device as defined in claim 18, wherein pull line means are secured to said intrauterine device to enable removal after insertion.

25. An intrauterine device as defined in claim 24, wherein said pull line means are secured to said nose portion.

26. An intrauterine device as defined in claim 24, wherein said pull line means are secured to said tail portion.

27. An intrauterine device as defined in claim 18, wherein thin webs integral with said perimetral portion are disposed on each side portion between at least two adjacent ones of said short spurs on each of said side portions.

28. An intrauterine device as defined in claim 27, wherein said thin webs are disposed between all adjacent pairs of short spurs in a row on each of said side portions.

29. An intrauterine device as defined in claim 27, wherein each of said thin webs between adjacent spurs in a row is attached only to said perimetral portion and is disposed loose between said adjacent spurs.

30. An intrauterine device as defined in claim 27, wherein each of said thin webs between adjacent spurs is attached to said perimetral portion and is also secured to said adjacent spurs.

31. An intrauterine device as defined in claim 27, wherein each of said thin webs is shorter than the length of said adjacent spurs.

32. An intrauterine device as defined in claim 31, wherein said shorter thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

33. An intrauterine device as defined in claim 31, wherein each of said shorter thin webs between adjacent spurs is attached only to said perimetral portion and is disposed loose from said adjacent spurs.

34. An intrauterine device as defined in claim 31, wherein each of said shorter thin webs between adjacent spurs is attached to said perimetral portion and is also secured to said adjacent spurs.

35. An intrauterine device as defined in claim 27, wherein said thin webs integral with the perimetral edge portion protrude outwardly from said perimetral portion a distance greater than the length of said adjacent spurs.

36. An intrauterine device as defined in claim 35, wherein said protruding thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

37. An intrauterine device as defined in claim 35, wherein each of said protruding thin webs between adjacent spurs is attached only to said perimetral portion and is disposed loose from said adjacent spurs.

38. An intrauterine device as defined in claim 35, wherein each of said protruding thin webs between adjacent spurs is attached to said perimetral portion and is also secured to said adjacent spurs.

39. An intrauterine device as defined in claim 1, wherein said central body includes a perimetral rim with thin membrane means across the inner diameter of said perimetral rim.

40. An intrauterine device as defined in claim 39, wherein said membrane means is connected to both side portions and provides openings adjacent said nose portion and said tail portion.

41. An intrauterine device as defined in claim 40, wherein said membrane means is connected to each side portion via a plurality of narrow membrane portions.

42. An intrauterine device as defined in claim 39, wherein a multiplicity of narrow spaced apart membrane portions interconnect a central portion of said membrane means to said perimetral rim.

43. An intrauterine device as defined in claim 42, wherein said multiplicity of membrane portions includes four portions secured to the inner edge of each said side portion of said rim.

44. An intrauterine device as defined in claim 39, wherein the axis of all of said plurality of spurs on each side portion are disposed in a common plane.

45. An intrauterine device as defined in claim 39, wherein at least a portion of said spurs have an inclination toward the tail portion.

46. An intrauterine device as defined in claim 39, wherein all of said spurs have a retrograde inclination toward the tail portion.

47. An intrauterine device as defined in claim 39, wherein the spurs closest to said nose portion are longer than the spurs closest to said tail portion.

48. An intrauterine device as defined in claim 39, wherein pull line means are secured to said intrauterine device to enable removal after insertion.

49. An intrauterine device as defined in claim 48, wherein said pull line means are secured to said nose portion.

50. An intrauterine device as defined in claim 48, wherein said pull line means are secured to said tail portion.

51. An intrauterine device as defined in claim 39, wherein thin webs integral with the outer edge of said perimetral portion are disposed on each side portion between at least two adjacent ones of said short spurs on each of said side portions.

52. An intrauterine device as defined in claim 51, wherein said thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

53. An intrauterine device as defined in claim 51, wherein each of said thin webs between adjacent spurs is attached only to said edge of said perimetral portion and is disposed loose between said adjacent spurs.

54. An intrauterine device as defined in claim 51, wherein each of said thin webs between adjacent spurs is attached to said edge of said perimetral portion and is also secured to said adjacent spurs.

55. An intrauterine device as defined in claim 51, wherein each of said thin webs is shorter than the length of said adjacent spurs.

56. An intrauterine device as defined in claim 55, wherein said shorter thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

57. An intrauterine device as defined in claim 55, wherein each of said shorter thin webs between adjacent spurs is attached only to said edge of said perimetral portion and is disposed loose from said adjacent spurs.

58. An intrauterine device as defined in claim 55, wherein each of said shorter thin webs between adjacent spurs is attached to said edge of said perimetral portion and is also secured to said adjacent spurs.

59. An intrauterine device as defined in claim 51, wherein said thin webs integral with the outer edge protrude outwardly from said perimetral portion a distance greater than the length of said adjacent spurs.

60. An intrauterine device as defined in claim 18, wherein said central body includes a perimetral rim with thin membrane means across the inner diameter of said perimetral rim.

61. An intrauterine device as defined in claim 60, wherein said membrane means is connected to both side portion and provides openings adjacent said nose portion and said tail portion.

62. An intrauterine device as defined in claim 61, wherein said membrane means is connected to each side portion via a plurality of narrow membrane portions.

63. An intrauterine device as defined in claim 60, wherein a multiplicity of narrow spaced apart membrane portions interconnect a central portion of said membrane means to said perimetral rim.

64. An intrauterine device as defined in claim 63, wherein said multiplicity of membrane portions includes four portions secured to the inner edge of each said side portion of said rim.

65. An intrauterine contraceptive device comprising: a central body having a perimetral ring portion with nose, tail and side portions and encompassing an area approximating that of an average normal condition uterine cavity, a plurality of short spurs extending outwardly from each of said side portions, and pull line means secured to said nose portion to enable removal after insertion.

66. An intrauterine device as defined in claim 65, wherein the axis of all of said plurality of spurs on each side portion are disposed in a common plane.

67. An intrauterine contraceptive device comprising: a central body having a perimetral ring portion with nose, tail and side portions and encompassing an area approximating that of an average normal condition uterine cavity, and a plurality of rows of short spurs extending outwardly from each of said side portions.

68. An intrauterine device as defined in claim 67, wherein the spurs in all of said rows on each of said side portions are side by side in a direction normal to the general planar shape of the device.

69. An intrauterine device as defined in claim 67, wherein the spurs in one of the adjacent rows on each side of said side portions are offset from the spurs in another of said adjacent rows on the same side of said side portion in a direction along the perimetral portion.

70. An intrauterine device as defined in claim 67, wherein at least a portion of said spurs have an inclination toward the tail portion.

71. An intrauterine device as defined in claim 67, wherein all of said spurs have a retrograde inclination toward the tail portion.

72. An intrauterine device as defined in claim 67, wherein the spurs closest to said nose portion are longer than the spurs closest to said tail portion.

73. An intrauterine device as defined in claim 67, wherein thin webs integral with the outer edge of said perimetral portion are disposed on each side portion between at least two adjacent ones of said short spurs on each of said side portions.

74. An intrauterine device as defined in claim 73, wherein said thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

75. An intrauterine device as defined in claim 73, wherein each of said thin webs between adjacent spurs is attached only to said edge of said perimetral portion and is disposed loose between said adjacent spurs.

76. An intrauterine device as defined in claim 73, wherein each of said thin webs between adjacent spurs is attached to said edge of said perimetral portion and is also secured to said adjacent spurs.

77. An intrauterine device as defined in claim 73, wherein each of said thin webs is shorter than the length of said adjacent spurs.

78. An intrauterine device as defined in claim 73, wherein said thin webs integral with the outer edge protrude outwardly from said perimetral portion a distance greater than the length of said adjacent spurs.

79. An intrauterine device as defined in claim 78, wherein said protruding thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

80. An intrauterine device as defined in claim 78, wherein each of said protruding thin webs between adjacent spurs is attached only to said edge of said perimetral portion and is disposed loose from said adjacent spurs.

81. An intrauterine device as defined in claim 78, wherein each of said protruding thin webs between adjacent spurs is attached to said edge of said perimetral portion and is also secured to said adjacent spurs.

82. An intrauterine contraceptive device comprising: a central body having a perimeter ring portion with nose, tail and side portions and encompassing an area approximating that of an average normal condition uterine cavity, thin membrane means across the inner diameter of said ring portion, a plurality of short spurs extending outwardly from each of said side portions, said membrane means including a plurality of narrow membrane portions connected to each side portion and providing openings adjacent said nose portion and said tail portion.

83. An intrauterine device as defined in claim 82, wherein said plurality of membrane portions includes four portions secured to the inner edge of each of the side portions of said rim.

84. An intrauterine device as defined in claim 82, wherein a plurality of rows of short spurs are disposed on each of said side portions.

85. An intrauterine device as defined in claim 84, wherein the spurs in all of said rows on each of said side portions are side by side in a direction normal to the general planar shape of the device.

86. An intrauterine device as defined in claim 84, wherein the spurs in one of the adjacent rows on each side of said side portions are offset from the spurs in another of said adjacent rows on the same side of said side portion in a direction along the perimetral portion.

87. An intrauterine device as defined in claim 82, wherein at least a portion of said spurs have an inclination toward the tail portion.

88. An intrauterine device as defined in claim 82, wherein all of said spurs have a retrograde inclination toward the tail portion.

89. An intrauterine device as defined in claim 82, wherein the spurs closest to said nose portion are longer than the spurs closest to said tail portion.

90. An intrauterine device as defined in claim 82, wherein pull line means is secured to said intrauterine device to enable removal after insertion.

91. An intrauterine device as defined in claim 90, wherein said pull line means is secured to said nose portion.

92. An intrauterine device as defined in claim 90, wherein said pull line means is secured to said tail portion.

93. An intrauterine device as defined in claim 82, wherein thin webs integral with the outer edge of said perimetral portion are disposed on each side portion between at least two adjacent ones of said short spurs on each of said side portions.

94. An intrauterine device as defined in claim 93, wherein said thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

95. An intrauterine device as defined in claim 93, wherein each of said thin webs between adjacent spurs is attached only to said edge of said perimetral portion and is disposed loose between said adjacent spurs.

96. An intrauterine device as defined in claim 93, wherein each of said thin webs between adjacent spurs is attached to said edge of said perimetral portion and is also secured to said adjacent spurs.

97. An intrauterine device as defined in claim 93, wherein each of said thin webs is shorter than the length of said adjacent spurs.

98. An intrauterine device as defined in claim 93, wherein said thin webs integral with the outer edge protrude outwardly from said perimetral portion a distance greater than the length of said adjacent spurs.

99. An intrauterine device as defined in claim 98, wherein said protruding thin webs are disposed between all adjacent pairs of short spurs on each of said side portions.

100. An intrauterine device as defined in claim 98, wherein each of said protruding thin webs between adjacent spurs is attached only to said edge of said perimetral portion and is disposed loose from said adjacent spurs.

101. An intrauterine device as defined in claim 98, wherein each of said protruding thin webs between adjacent spurs is attached to said edge of said perimetral portion and is also secured to said adjacent spurs.

102. An intrauterine device as defined in claim 1, wherein the portion of each bulbous spur located near said perimetral portion has a smaller cross-section than that of the portion adjacent the spur terminal end.

103. An intrauterine device as defined in claim 102, wherein each of the bulbous spurs has an effective tear-drop configuration.

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104. An intrauterine device as defined in claim **102**, wherein the terminal end of each bulbous spur has an enlarged knob.

105. An intrauterine device as defined in claim **102**, wherein the terminal end of each bulbous spur is substantially spherical.

106. A intrauterine device as defined in claim **18**, wherein the portion of each bulbous spur located near said perimetral portion has a smaller cross section than that of the portion adjacent the spur terminal end.

107. An intrauterine device as defined in claim **106**, wherein at least a portion of said plurality of bulbous spurs each has an effective teardrop configuration.

108. An intrauterine device as defined in claim **106**, wherein the terminal end of at least a portion of said plurality of bulbous spurs has an enlarged knob.

109. An intrauterine device as defined in claim **106**, wherein the terminal end of at least a portion of said plurality of bulbous spurs is substantially spherical.

110. An intrauterine device as defined in claim **109**, 20

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wherein the configuration of each spur in another portion of said plurality of bulbous spurs has an effective teardrop shape.

111. An intrauterine device as defined in claim **67**, wherein at least a portion of said plurality of spurs are bulbous and the portion of each said bulbous spur located near said perimetral portion has a smaller cross section than the portion adjacent the spur terminal end.

112. An intrauterine device as defined in claim **111**, wherein at least a portion of a plurality of said bulbous spurs each has an effective teardrop configuration.

113. An intrauterine device as defined in claim **111**, wherein the terminal end of at least a portion of a plurality of bulbous spurs has an enlarged knob.

114. An intrauterine device as defined in claim **111**, wherein the terminal end of each of at least a portion of a plurality of bulbous spurs is substantially spherical.

115. A device as defined in claim **1** made from a plastic material comprising an ethylene vinyl copolymer.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,782,376 Dated January 1, 1974

Inventor(s) Irwin S. Lerner

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

Column 6, line 38, change "aobut" to --about--.

Column 8, line 9, change "provdie" to --provide--.

Column 9, printed line 50, change "loated" to --located--.

Column 9, printed line 54, change "inserted" to --insert--.

Column 10, printed line 64, change "strick" to --stick--.

Column 10, printed line 65, change "stick" to --is--.

Column 17, line 23, change "aech" to --each--.

Column 17, line 34, change "sre" to --are--.

Signed and sealed this 7th day of May 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents