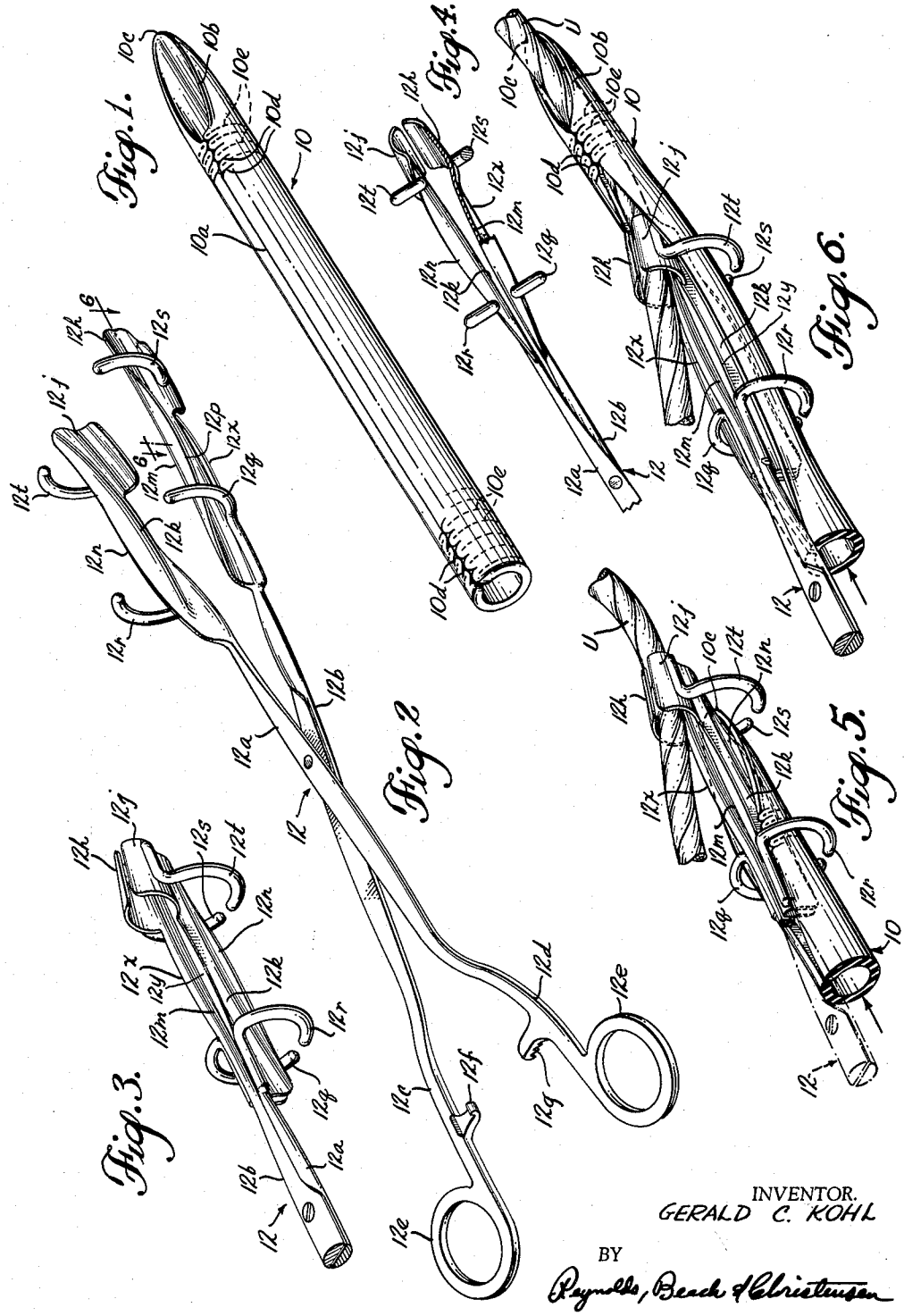
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UMBILICAL CORD PROTECTOR SHEATH AND APPLICATOR INSTRUMENT THEREFOR

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UMBILICAL CORD PROTECTOR SHEATH AND APPLICATOR INSTRUMENT THEREFOR

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This invention relates to obstetrical instruments and more particularly concerns new and improved means for safeguarding an infant during childbirth against injury or death caused by compression of the umbilical cord. The invention is herein illustratively described by reference to the presently preferred form thereof; however, it will be recognized that certain modifications and changes therein with respect to details may be made without departing from the essential features involved.

There are two major instances during childbirth in which the umbilical cord may become dangerously compressed. One is the case of a prolapsed umbilical cord and the other is the case of cord compression by the after-coming head in breach deliveries. Attempts to treat a prolapsed cord condition, consisting of efforts to work the cord up into the uterus prior to or during emergence of the infant's head are not always successful. Compression of the cord during breach deliveries sometimes creates an even more difficult situation. In both cases if the cord remains compressed for as long as about eight minutes, loss of oxygenated blood supply to the infant's body causes mental retardation, vegetablism or death. Moreover, when difficulty does arise in these situations efforts to hasten the delivery may result in maiming of the infant or actual death by obstetrical trauma. There are few obstetricians even of great judgment and skill who do not have haunting memories of such tragedies.

An object of the present invention is to provide an umbilical cord protector sheath which may be applied to the cord successfully in many of these otherwise dangerous cases and will serve to prevent dangerous compression of the cord.

A related object is such a protector sheath of versatile and adaptable form suiting it for use under varying conditions encountered in prolapse or breach birth cases.

Still another object is a protector which may be applied rapidly and safely and which is relatively inexpensive to manufacture so that it may be provided economically in different calibers and sizes in order to meet the requirements of different cord sizes and case situations.

Still another object of this invention is a novel instrument for threading the protector sheath onto the umbilical cord for the described purposes. Such instrument is designed for convenience and facility in the rapid application of the protector sheath in the varying case situations likely to be encountered and for which the protector is adapted.

It is recognized that there are certain possible case situations, particularly in breach cases, in which the improved means comprising this invention may not be readily applicable, if at all. For example, the extension of the umbilical cord around an extremity of the infant in breach position may preclude the application of the cord protector at least to that portion of the cord. Furthermore, a true knot in the cord will ordinarily prevent application of the protector to that portion of the cord. However, true knots within ten inches of the infant, also extensions of umbilical cords around extremity points are

not common situations. Moreover the attending physician may determine quickly whether the protector may be applied in a given case and if not will have lost no appreciable time in so doing. The improved protector is almost always applicable in prolapse cases. In the many cases wherein the invention applies the operator is afforded much more time than usual for conducting a safe and leisurely delivery even allowing for molding of the head.

The improved umbilical cord protector comprises an elongated resiliently flexible round tubular sheath having a longitudinal slit therein and sufficient wall flexibility to permit spreading apart the sides thereof of the slit for application to the umbilical cord, resilience of the walls causing them to reclose around the cord and stiffness of the walls preventing crushing of the cord. Preferably the leading end of the sheath is beveled and rounded to facilitate displacing tissues and bypassing obstructions as it advances during application thereof to the cord. Additional features reside in the provision of a plurality of circumferentially extending stiffener elements in the sheath at successive locations along the length thereof, which stiffeners do not materially impair its flexibility for spreading apart the sides thereof to receive the umbilical cord but which add materially to the stiffness of the wall against compression.

The novel applicator instrument or jack comprises means for holding the cord in predetermined relation to the instrument and guide means extending from the holder means at a slight angle and adapted for spreading apart the sides of the sheath at the location of the holder so that the slitted sheath is spread apart to pass over the holder means and over the cord, whereupon inherent resilience of the sheath causes it to close around the cord progressively as the sheath is advanced along the guide means. Additional features of construction of the applicator instrument and novel protector sheath will become evident from the following description by reference to the accompanying drawings.

Figure 1 is a perspective view of the protector sheath in its presently preferred form.

Figure 2 is a perspective view of the preferred embodiment of the novel applicator instrument with the tongs carrying the clamp and guide elements in open position preparatory to gripping an umbilical cord.

Figure 3 is a perspective view of the tongs end of the applicator instrument with the tongs closed, the view showing the instrument in a position inverted with respect to that in Figure 2.

Figure 4 is a top view of the operating end of the instrument with the tongs closed, to show the divergence of the guide elements and their mergence with the respective clamp elements for spreading the sheath sides to thread the sheath over the cord.

Figures 5 and 6 are operating views showing application of the cord protector sheath with the use of the applicator instrument.

As shown the protector sheath 10 is of elongated tubular form and is preferably made of a resiliently flexible material such as rubber or a rubber-like material. Some plastic materials may be suitable although surgical rubber such as that used in endotracheal catheter tubes is preferred. The internal bore size of the tube is preferably slightly in excess of the diameter of the umbilical cord to be protected. Since umbilical cords vary in size it is desirable to provide protector sheaths of varying caliber. Moreover, the length of the stretches of umbilical cord requiring protection and capable of receiving the protective sheath may vary, thus making it desirable to provide protector sheaths of varying lengths as well as varying calibers. For instance, in prolapsed cord cases the length of the protector sheath should be adequate to

reach from the entroitus to beyond the brim of the bony pelvis. The varying positions and shapes assumed by umbilical cords in the case of breech births make it desirable to have a considerable variation of the lengths of available protectors. In prolapse cases the cord is looped and there are two cord stretches, therefore, which should be protected, requiring two protector sheaths usually of the same length and bore.

The improved protector sheath **10** is slitted lengthwise at **10***a*, preferably from end to end, and one end of the sheath (the leading end during application) is beveled as at **10***b*. The beveled end edge is preferably smoothly rounded and the tip thereof **10***c* is also rounded in the plane of the bevel so as to minimize any possibility of tissue damage. At the same time the bluntly rounded tip afforded by beveling the leading end of the protector sheath facilitates applying the sheath and advancing it past tissues and obstructions which may otherwise interfere with application of the sheath. The bevel lies substantially in a plane which forms an acute angle of the order of 20 degrees with the sheath axis. The tip is diametrically opposite the line of the slit **10***a*.

As a further feature of the protector sheath it is provided with circumferential slits **10***d* at successive locations along the length thereon on either side of the longitudinal slit **10***a*. Preferably the slit locations on opposite sides of the longitudinal slit are staggered or alternated in position. In a typical case these slits extend about one-sixth the circumference of the sheath at one centimeter intervals. The slits may extend along the entire length of the sheath or along only one or more portions thereof. In some cases slitting is unnecessary, depending on the materials and wall construction used in the sheath. The purpose of the slits is to make for ease in passing the sheath over the jack and onto the cord.

Preferably resilient wires **10***e* in the form of split rings are embedded in the sheath at successive locations along the length thereof. These also may occupy locations which may extend the full length of the sheath or along only one or more portions thereof. Usually they will be used adjacent the beveled end thereof to insure initial closing of the separated sheath sides around the cord during initial application; however, with certain wall materials the wires or equivalent stiffeners may be omitted in favor of greater economy of manufacture. Their function is to increase the rigidity of the sheath against compression without materially impairing its flexibility for spreading apart the sides at the location of the longitudinal slit **10***a*. If desired the split rings **10***e* may be articulated or hinged at one or more locations intermediate their ends to permit spreading apart the sides of the sheath readily without encountering the stiffness of the wires, while permitting them to act as a rigid reinforcement against compression of the sheath.

The applicator instrument or jack **12** comprises pivoted tongs **12***a* and **12***b* having handles **12***c* and **12***d* provided with finger stalls **12***e*. A conventional ratchet type lock comprising a pawl element **12***f* and a complementally formed toothed element **12***g* is provided to hold the prongs in successive closed positions in the manner of conventional clamp instruments.

The applicator further comprises umbilical cord holder or clamp means comprising complementally formed elements **12***h* and **12***j* mounted on the ends of tongs **12***b* and **12***a* at a slightly offset location on one side of the instrument and adapted to grip and hold a stretch of umbilical cord therein as shown in Figures 5 and 6. These clamp elements are preferably formed as semicircular sections which together define the outline of a tube whose axis extends at a small angle in relation to the general plane of the instrument. Thus an umbilical cord gripped between the clamp elements as in Figures 6 and 5 extends generally lengthwise of the instrument with a slight angularity between the cord axis and the plane of the instrument. Since the clamp elements are mounted on the ends of the tongs the clamp may be opened simply by separating the tongs as shown in Figure 2.

In order to jack the tubular protector sheath **10** onto the umbilical cord U gripped in the clamp means, special guide means, including slit spreader and sheath retainer means, are provided on the applicator. Such guide means preferably comprise elongated oppositely disposed spreader guide elements **12***k* and **12***m* of elongated form extending generally lengthwise from the tongs **12***a* and **12***b* and joined at their relatively outer ends to the respective clamp elements **12***h* and **12***j*. In effect the elements **12***k* and **12***m* comprise longitudinal extensions of the respective tongs **12***a* and **12***b* supporting and merging into such clamp elements. With the clamp elements in closed position as shown in Figures 3 and 4 the relatively outside longitudinal surfaces of the guide elements **12***m* and **12***k* diverge in relation to each other toward the clamp elements **12***h* and **12***j*. These guide elements are slidably engageable by the longitudinal slit edges of the protector sheath **10** advanced thereover from the handle end of the instrument so as to spread apart the sides of the protector sheath in order to pass the sheath over the clamp means and onto an umbilical cord U extending therefrom. The relatively outer longitudinal surfaces of the guide elements **12***k* and **12***m* merge with the corresponding surfaces of the respective clamp elements to effect a gradual transition in curvature of the slit edges and minimize friction in the advancement of the sheath onto the cord.

Retainer elements **12***n* and **12***p* in the form of longitudinally extending flanges or wings projecting laterally from corresponding edges of the respective guide elements **12***k* and **12***m* on the side of the instrument generally opposite the direction of offset of the clamp elements enter the interior of the advancing protector sheath and lodge behind the longitudinal slit edges thereof in order to aid in holding the protector sheath on the guide elements during its advancement onto the cord U. Preferably such retainer elements **12***n* and **12***p* taper in width longitudinally from their mid portions toward both ends thereof on a gradual curve so as to minimize resistance thereof to passage of the guide tube of the protector sheath onto the cord. By making them sufficiently wide in their lateral projecting extent these elements may facilitate spreading of the sheath sides to pass the same over the clamp members. Flanges **12***x* and **12***y* on the opposite longitudinal edges of the guide elements from the retainer elements **12***p* and **12***h* also serve as retainers preventing the slit edges of the sheath from slipping off guide elements **12***m* and **12***k* particularly during the initial advancement of the sheath upon the instrument.

In addition, tongs **12***a* and **12***b* carry the complementally formed parts or halves **12***q* and **12***r* of a first guide ring mounted near the handle or base end of the guide elements **12***m* and **12***k* and the similar parts **12***s* and **12***t* of a second guide ring mounted near the outer end of such guide elements, on the respective clamp elements **12***h* and **12***j*. In the closed position of the tongs these split rings encircle the protector sheath as the same is advanced along the guide means and over the clamp means to engage the umbilical cord. The combined retaining effect of the retainer elements and guide rings insure the proper advancement of the protector sheath onto the umbilical cord under operating conditions in which the entire control is by palpation and/or inspection.

In use in the case of a breach birth, as soon as the cord presents before the after-coming head a protector sheath of proper size is selected and an applicator instrument of proper size to accommodate the protector sheath and umbilical cord is selected. One stretch of the umbilical cord U is gripped and held in the clamp means **12***h*, **12***j*. The locking elements **12***f* and **12***g* are interengaged so that the operator is free to release the handles for applying the protector sheath with both hands in use. The guided sheath advancing over the spreader

surface 12*k* and 12*m* passes over the clamp means 12*h*, 12*j* and thereby over the umbilical cord U emerging therefrom generally in a direction endwise of the instrument. Resilience of the walls of the protector sheath cause the longitudinal slit 10*a* thereof to reclose around the umbilical cord (Figure 5) at the successive portions of the protector sheath advanced beyond the clamp means as shown. The operator presses the protector sheath endwise until the entire length thereof has passed over the clamp means and onto the stretch of umbilical cord. In the process of effecting this operation the tip of the protector sheath is directed just lateral to the sacral prominence, either right or left, in the space or sulcus between the sacral promontory and the wing of the sacrum. It is then advanced beyond the bony brim of the pelvis into the uterus and beyond the points of compression of the baby's head and soft parts.

In the case of a prolapsed cord two protector sheaths are always used, one to protect each stretch or side of the prolapse loop. Each such protector is passed over each limb of the prolapsed cord and beyond the presenting part into the uterine cavity.

With the proper use of the novel protector sheath and applicator instrument it is believed that most potentially dangerous cases of prolapsed cord and breach birth may be successfully treated which otherwise could result in the death or serious injury of the infant.

As previously mentioned, it will be recognized that the invention is described and illustrated herein by way of example and that certain details pertaining to the design and construction of the protector sheath itself and to the applicator instrument may vary within the scope of the inventive concepts.

I claim as my invention:

1. An umbilical cord protector comprising an elongated resiliently flexible round tube of an internal cross-section slightly exceeding the external cross-section of an umbilical cord to be protected, said tube having a slit extending longitudinally thereof from one end and a wall flexibility adapting the sides of the tube to be spread apart forcibly at the slit to receive the umbilical cord first at said one end of the tube and then progressively along the length of the tube, resilience of the tube wall causing the slit to reclose around the umbilical cord progressively along the tube's length as the cord is lodged therein and the spread-apart sides released, said wall being substantially relaxed in the reclosed condition of said slit, whereby the slit edges are not forced past each other to squeeze the cord in the tube, longitudinal flexibility of the tube adapting the same to conform to the shapes of spaces between maternal and fetal surfaces occupied by the cord, and said tube having inherent wall stiffness ample to resist flattening thereof under pressures attending child delivery which are sufficient to cut off blood flow through the umbilical vein in an unprotected cord, one end of said tube being beveled at an acute angle in relation to the longitudinal axis of the tube, with the tip of such beveled end being in a longitudinal line substantially diametrically opposite the line of the slit, and with the beveled end edge being smoothly rounded, such beveling and rounding minimizing the possibility of laceration of tissues and facilitating sliding the tube lengthwise on and along the umbilical cord and past potential obstructions.

2. The umbilical cord protector defined in claim 1, wherein tube comprises a flexible rubber-like material having circumferentially extending resilient metal stiffener elements therein located at successive intervals along at least a portion of the length thereof commencing with the said one end thereof, to increase the resistance of the tube to flattening without materially impairing longitudinal flexibility and flexibility to spreading of the sides of the tube at the slit to receive the cord therein.

3. The umbilical cord protector defined in claim 2, wherein the tube is slit circumferentially a small fraction of its circumference at and from both sides of the longitudinal slit at a succession of locations along the length thereof to facilitate application of the tube to the umbilical cord.

4. An umbilical cord protector comprising an elongated resiliently flexible round tube of an internal cross-section slightly exceeding the external cross-section of an umbilical cord to be protected, said tube having a full-length straight slit extending longitudinally thereof from one end and a wall flexibility adapting the sides of the tube to be spread apart forcibly at the slit to receive the umbilical cord first at said one end of the tube and then progressively along the length of the tube, said one end having a bluntly pointed tip formed by beveling such end of the tube from the location of the slit, resilience of the tube wall causing the slit to reclose around the umbilical cord progressively along the tube's length as the cord is lodged therein and the spread-apart sides released, longitudinal flexibility of the tube adapting the same to conform to the shapes of spaces between maternal and fetal surfaces occupied by the cord, and said tube having inherent wall stiffness ample to resist flattening thereof under pressures attending child delivery which are sufficient to cut off blood flow through the umbilical vein in an unprotected cord.

5. The umbilical cord protector defined in claim 4, wherein the tube is slit circumferentially a small fraction of its circumference at and from both sides of the longitudinal slit at a succession of locations along the length thereof to facilitate application of the tube to the umbilical cord.

6. An umbilical cord protector comprising an elongated resiliently flexible round tube of an internal cross-section slightly exceeding the external cross-section of an umbilical cord to be protected, said tube having a slit extending longitudinally thereof from one end and a wall flexibility adapting the sides of the tube to be spread apart forcibly at the slit to receive the umbilical cord first at said one end of the tube and then progressively along the length of the tube, a plurality of circumferentially extending elements embedded in the tube at successive locations along the length thereof reinforcing the same against being flattened under compression without correspondingly stiffening the same against separation of the sides at the split, resilience of the stiffened tube wall causing the slit to reclose around the umbilical cord progressively along the tube's length as the cord is lodged therein and the spread-apart sides released, longitudinal flexibility of the tube adapting the same to conform to the shapes of spaces between maternal and fetal surfaces occupied by the cord, and said reinforced tube having inherent wall stiffness ample to resist flattening thereof under pressures attending child delivery which are sufficient to cut off blood flow through the umbilical vein in an unprotected cord.

7. An instrument for applying an elongated longitudinally slitted flexible tubular protector sheath to an umbilical cord to prevent crushing of the cord during childbirth, said instrument comprising clamp means adapted for gripping and holding a stretch of umbilical cord extending therethrough in a predetermined direction relative to the instrument, and guide means adjoining said clamp means in predetermined relation thereto and adapted for threading the protector sheath progressively over the umbilical cord so held by said clamp means, said guide means having relatively oppositely disposed guide elements slidably engageable by the longitudinal slit edges of the sheath and diverging relatively in the direction of the clamp means and merging with relatively opposite sides of said clamp means for spreading apart the sides of such sheath whereby the latter may be advanced over the clamp means and along the umbilical cord held therein by progressive advance of the sheath along said guide means in the direction toward said clamp means, said guide elements terminating substantially at said clamp means to permit

progressive reclosure of successive portions of the sheath advancing beyond the clamp means for surrounding the umbilical cord thereby.

8. The instrument defined in claim 7, wherein the guide means further comprises sheath-retainer elements carried by the respective guide elements at corresponding relative locations thereon to enter the tubular sheath to lodge therein behind the slit edges, said retainer elements being formed to help hold the sheath against dislodgement laterally from said guide elements during advancement of the sheath onto the umbilical cord.

9. The instrument defined in claim 8, wherein the clamp means comprises two separate opposing clamp elements adjoining the respective guide elements, and wherein the instrument further comprises elongated pivoted tongs, one clamp element and associated guide element being carried by each of the respective tongs.

10. The instrument defined in claim 9, and at least one annular guide member comprising a pair of semi-annular elements carried by the respective tongs and projecting transversely therefrom in complementally disposed relationship to extend at least part way around a sheath being advanced over the clamp means, thereby to help retain the advancing sheath on the guide elements.

11. The instrument defined in claim 7, and at least one annular guide member comprising a pair of semi-annular elements carried by the respective tongs and projecting transversely therefrom in complementally disposed relationship to extend at least part way around a sheath being advanced over the clamp means, thereby to help retain the advancing sheath on the guide elements.

12. The instrument defined in claim 7, wherein the clamp means comprises two separate opposing clamp elements adjoining the respective guide elements, and wherein the instrument further comprises elongated pivoted tongs, one clamp element and associated guide elements being carried by each of the respective tongs.

13. An instrument for applying an elongated longitudinally slitted flexible tubular protector sheath to an umbilical cord to prevent crushing of the cord during childbirth, said instrument comprising clamp means adapted for gripping and holding a stretch of umbilical cord extending therethrough in a predetermined direction relative to the instrument, and elongated guide means projecting generally endwise from said clamp means, said guide means having relatively oppositely disposed guide elements slidably engageable by the longitudinal slit edges of the sheath and diverging relatively in the direction of the clamp means for spreading apart the sides of such sheath whereby the latter may be advanced over the clamp means and along the umbilical cord held therein by progressive advance of the sheath along said guide means in the direction toward said clamp means.

14. An instrument for applying an elongated longitudinally slitted flexible tubular protector sheath to an umbilical cord to prevent crushing of the cord during childbirth, said instrument comprising elongated handle means, holder means carried by one end of said handle means and adapted for retaining a stretch of umbilical cord to emerge from one end thereof in a predetermined general direction relative to the length of said handle means, and guide means on said handle means, adapted to enter the open end of the protector sheath as the same is advanced lengthwise generally along said handle means, said guide means including guide elements extending along said handle means substantially to said holder means at a slight angle in relation to the direction of the emerging cord, said guide elements being spaced apart transversely of said handle means to spread apart the sides of the sheath at the slit thereof to thread the same over said holder means and emerging umbilical cord by progressive advancement of the sheath along the handle means.

15. An instrument for applying an elongated longitudinally slitted flexible tubular protector sheath to an umbilical cord to prevent crushing of the cord during childbirth, said instrument comprising elongated relatively divergent spreader elements materially shorter than the sheath and adapted for entering the slitted sheath to spread apart the sides thereof at the slit at successive locations therealong as the sheath is advanced lengthwise over said spreader elements, and umbilical cord holder means adapted to engage and hold a stretch of umbilical cord and connected to the spreader elements in such position relative thereto so as to hold such cord between the divergent ends of said spreader elements with the cord extending generally lengthwise of such elements beyond said divergent ends thereof, whereby advancement of such sheath over said spreader elements causes threading of the sheath onto the umbilical cord.

References Cited in the file of this patent

UNITED STATES PATENTS

1,224,259	Bement et al.	May 1, 1917
1,435,311	Knight	Nov. 14, 1922
1,988,435	Beebe	Jan. 22, 1935
2,229,849	Heidebrecht	Jan. 28, 1941

FOREIGN PATENTS

989,446	France	May 23, 1951
701,380	Great Britain	Dec. 23, 1953