

- [54] **SURGICAL RETRACTOR**
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Related U.S. Application Data

- [63] Continuation-in-part of Ser. No. 230,299, March 1, 1972.
- [52] **U.S. Cl.**..... 128/20, 128/17
- [51] **Int. Cl.**..... **A61b 17/02**
- [58] **Field of Search** 128/17, 18, 20, 344, 128/345

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[57] **ABSTRACT**

This surgical retractor has a pair of opposed slat-like sides interconnected by an elastic V-shaped end piece so that the side slats are elastically bowed in arcuate paths with the concave sides of the slats facing each other. Each of the slats has cooperating ratchet and pawl arrangements to permit substantially free lengthwise extension and restricted lengthwise retraction for enlarging the size of the retractor. An extensible inflatable tube extends around the retractor and is intermittently connected thereto for extending the retractor in response to increasing fluid pressure in the tube.

12 Claims, 5 Drawing Figures

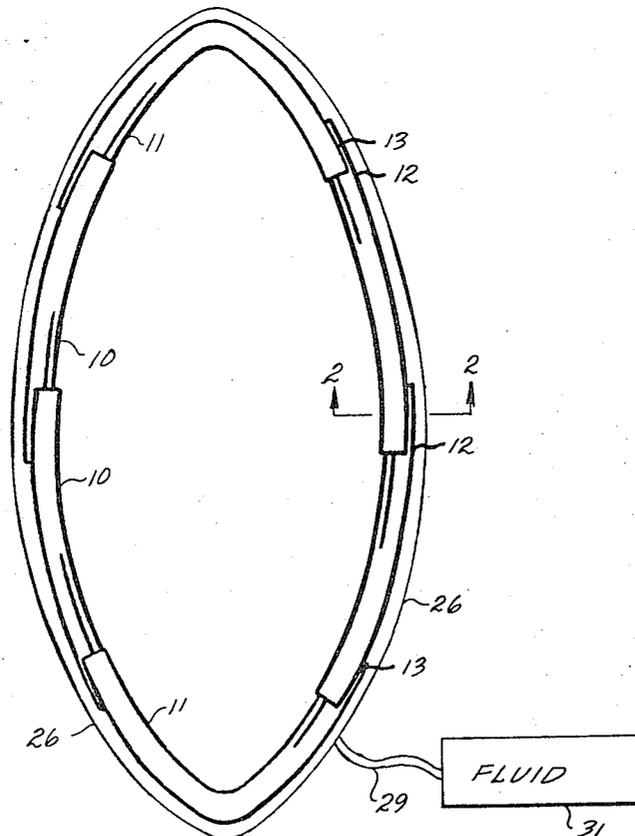


Fig. 1

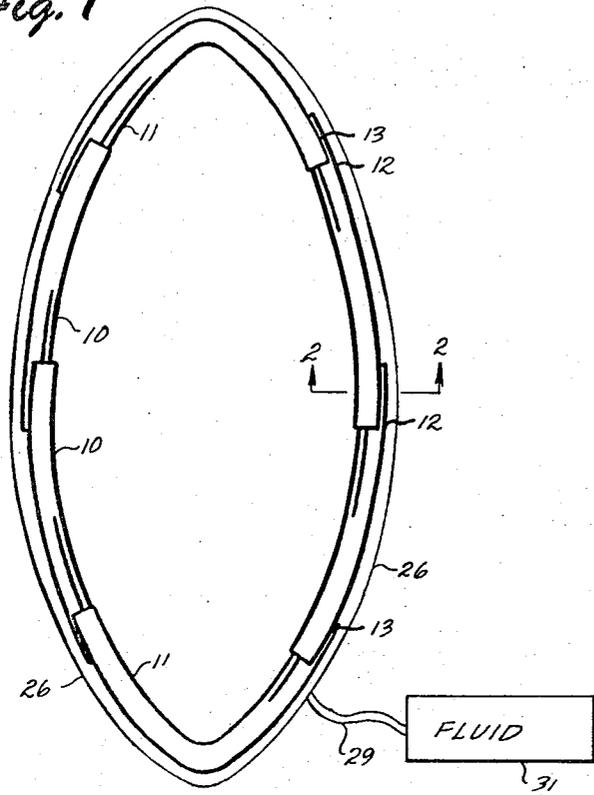


Fig. 3

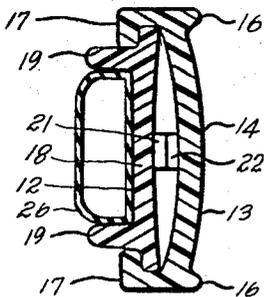
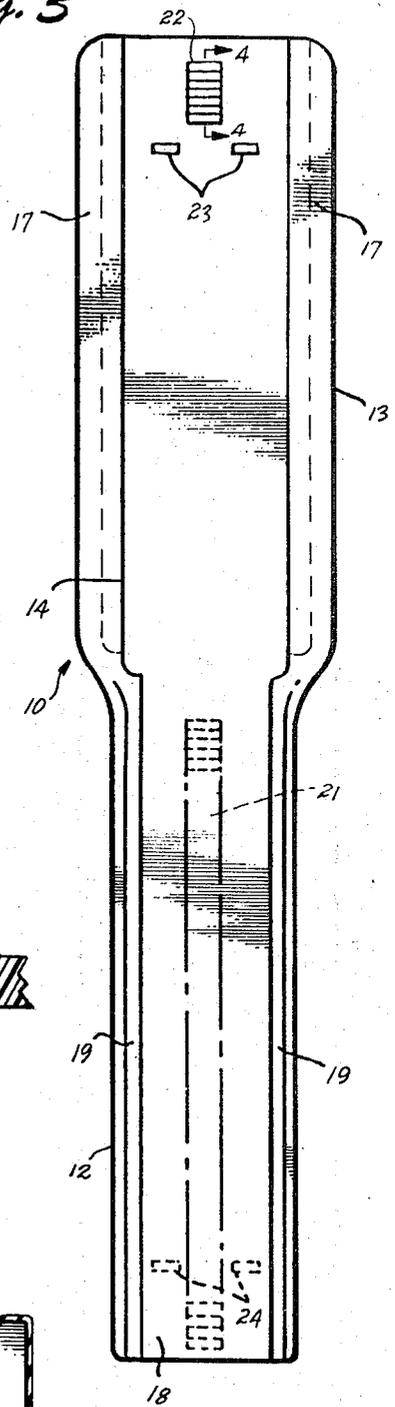
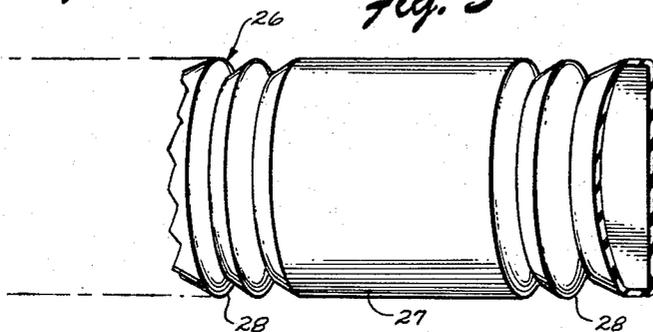


Fig. 4

Fig. 2

Fig. 5



SURGICAL RETRACTOR

This application is a continuation-in-part of my co-pending application, Ser. No. 230,799, filed Mar. 1, 1972.

BACKGROUND OF THE INVENTION

Surgical retractors are used for spreading apart or separating the walls of natural body orifices or for spreading the margins of surgical incisions. With the edges of an incision spread apart, the surgeon has access to the underlying tissues or organs permitting a clear view of the surgical site and access for a desired surgical or medical treatment. Thus, for example an abdominal retractor may be used in an abdominal incision to hold back the skin, subcutaneous fat and the internal peritoneal wall for ready access to the many abdominal organs.

In the past, a variety of surgical retractors have been employed. Hand retractors are typically steel instruments with a broad hook-like flap at one end for fitting over the tissue to be retracted. These are then pulled apart by hand and may be held or clamped during the surgical procedure. Some surgical retractors have arms that are interconnected by a gear or rack and pinion arrangement so that they can be cranked apart and locked in position. Another surgical retractor has four pivotally connected, rigid, curved links which can be clamped in any desired position to hold an incision open. Still another surgical retractor has a rigid peripheral ring with multiple detachable and movable blades that can be clamped at any point on the ring to hold a surgical site open.

Typically, such instruments have been made of stainless steel so as to be sterilizable between surgical procedures. The instruments are relatively heavy and stout because, in some cases, substantial forces may be involved in opening an incision and keeping it open. Since specially made, the instruments are expensive and it is costly to repetitively sterilize them and maintain sterility for surgery. Some of the more complicated retractors need to be taken apart for cleaning after surgery and reassembled before use.

It is desirable to provide a retractor that is sufficiently inexpensive that it can be disposed of after a single use thereby obviating cleaning and sterilization between uses. Such an instrument should be simple, rugged and versatile. Preferably such a retractor is enlarged without excessive effort on the part of the surgical staff.

BRIEF SUMMARY OF THE INVENTION

There is, therefore, provided in practice of this invention according to a presently preferred embodiment a surgical retractor having a pair of elongated elastic slats interconnected at their respective ends by a V-shaped end piece with divergence at each end so that the slats elastically bow in arcuate paths therebetween. Ratchet means are provided for freely extending the length of the slats and resisting longitudinal contraction thereof. An extensible inflatable tube may be used around the retractor for extension thereof in response to fluid pressure.

DRAWINGS

These and other features and advantages of the present invention will be appreciated as the same becomes better understood by reference to the following detailed description of a presently preferred embodiment

when considered in connection with the accompanying drawings wherein:

FIG. 1 illustrates in a general plan view a surgical retractor constructed according to principles of this invention;

FIG. 2 is a transverse cross section of one extendible side arm of the retractor of FIG. 1;

FIG. 3 illustrates in side view a side piece for the surgical retractor;

FIG. 4 is a fragmentary longitudinal cross section of an extension ratchet on the side piece; and

FIG. 5 is a fragmentary perspective view of an inflatable extension tube on the retractor.

DESCRIPTION

FIG. 1 illustrates in plan view an embodiment of surgical retractor constructed according to principles of this invention. As illustrated in this embodiment, a pair of elastically bendable and freely extensible side slats are each formed of a pair of extension pieces 10. At each end of the surgical retractor, there is a somewhat V-shaped end piece 11 so that the retractor has a generally elongated double curved outline approximately as illustrated in FIG. 1. The elastically bent side pieces 10 are interconnected by the end pieces 11 which are also elastic but with a somewhat higher section modulus adjacent the tip of the V to maintain the desired shape.

Each of the side slat pieces 10 has a male cross section for about half its length and a female cross section for about half its length. An outside view of one of the side slats is seen in FIG. 3. One end 12 has a male cross section and the other end 13 has a female cross section illustrated in the transverse cross section of FIG. 2.

FIG. 2 is a transverse cross section of a pair of the side slats in the portion where the male and female portions 12 and 13, respectively, are engaged. The female member 13 has a curved web 14 forming its principal vertical extent. On its inner or concave side, that is, the side facing the male portion 12 of the other side slat of the surgical retractor, the female end has a raised lip 16 along the top and bottom edges. On its outside face, the female end has a pair of hook-like flanges 17 extending along the length. Very broadly, the female end thus has a transverse cross section somewhat like an I-beam.

The male end 12 also has a curved web 18 extending as the principal portion of its height. The curvature of the two webs 14 and 18 is such that they bow apart from each other. The opposite edges of the web 18 fit into the re-entrant channel formed by the hook-shaped flanges 17 on the female portion. Thus, the male end is kept captive in a transverse direction but is free to slide in a longitudinal direction along the female end of an adjacent piece. A pair of ribs 19 extend outwardly from the web 18 along the length of the male portion. The ribs 19 are spaced a short distance apart from the edges of the web 18 so as to clear the tips of the hook-shaped flanges 17. Thus, the male portion of the side slat piece has a transverse cross section somewhat in the shape of a bench or Greek letter pi.

A series of ratchet teeth 21 extend along the length of the inside of the web 18 on the male end. A short row of pawl teeth 22 are provided on the outer face of the web 14 on the female end as may be seen in FIG. 4 which comprises a fragmentary longitudinal cross section thereof.

As best seen in FIG. 2, the pawl teeth 22 engage the ratchet teeth 21 between the webs 14 and 18 of the female and male ends of adjacent pieces. The teeth of the ratchet and pawl are oriented to permit motion in a direction tending to extend the length of the side slat formed of the interconnected male and female ends of the extension pieces. The teeth inhibit or restrict lengthwise contraction of the side slat. The pawl teeth can ride over the ratchet teeth due to elastic deformation of the webs 14 and 18 as cammed apart by the teeth.

The end V-shaped pieces 11 are also provided with male and female end portions analogous to those on the side slat extension pieces. This permits assembly of any desired combination of end and side pieces and relative extension of the end piece relative to a side piece as well as extension between a pair of adjacent side pieces.

When it is desired to release the ratchet and pawl arrangement thus provided, one need only pinch the female portion at its side edges adjacent the flanges 17. Such pinching causes the curved webs to bend further and be spaced apart a greater distance at their mid section thereby disengaging the pawl teeth from the ratchet teeth and permitting the side slats to be contracted in a lengthwise direction.

A pair of stop teeth 23 are provided on the web 14 of the female portion and a corresponding pair of stop teeth 24 are provided on the web 18 of the male portion. These teeth 23 and 24 face oppositely to the ratchet and pawl teeth. This permits the male end of one extension piece to be inserted into the female end of another extension piece, however, it limits the extent of withdrawal of the two parts so that over-extension of the side slats is avoided.

In order to use the surgical retractor in, say, an abdominal incision, the incision is made and the retractor inserted in a contracted state. Typically, the side slats are substantially straight or only slightly curved when made and when inserted into the incision. The side slats may be held close to each other when the retractor is inserted. The flesh to be retracted fits between the two ribs 19 on the male portions of the slat length and the flanges 17 on the female member along the rest of the slat length and is, hence, held substantially captive in the channels adjacent the webs 18 and 14.

After positioning the retractor in the incision, the two side slats may be spread apart. As the slats diverge adjacent their ends as they are spread apart, they elastically bend along their length in a plane transverse to the webs. This elastic bowing of the side slats forms a double curved opening between the sides of the retractor approximately as shown in FIG. 1. In addition to increasing divergence of the side slats, their length may also be increased merely by forcing the two end portions of the surgical retractor away from each other. This activates the ratchet and pawl arrangement between the male and female portions and permits longitudinal extension of the retractor. Such longitudinal extension may be employed for lengthening the available surgical site or may merely provide the additional length required as the side slats are bowed apart. It will be noted that as the stresses due to tissue being retracted increase as the surgical site is opened, the curvature of the side slats typically increases as well thereby strengthening the slats against buckling. Since both the angle at the end of the slats and the length of

the slats is adjustable, the retractor is quite versatile and may be used in long narrow openings or short wide ones.

When it is desired to close the surgical site, the retractor can be collapsed quite readily. The length of the side slats is decreased by pinching the upper and lower edges of the side slats adjacent the pawl teeth towards each other thereby further bowing the webs 14 and 18 and disengaging the pawl teeth 22 from the ratchet teeth 21. The male portion can then slide into the female portion freely for contracting the side slats.

A surgical retractor as described can be enlarged by manually spreading the sides and extending the slats. It may be desirable, however, for minimized effort to provide means for extending the retractor in response to increasing fluid pressure. An extensible inflatable tube 26 is therefore provided around the outside of the surgical retractor. As best seen in FIG. 2, the tube 26 lies against the web 18 between the ribs 19 on the outside of the retractor. Preferably the cross section of the tube is flattened to fit rather closely between the ribs without extending outwardly a great distance. In those portions of the periphery of a surgical retractor where the tube is adjacent a female portion of the side or end pieces it lies between and is generally held captive by the flanges 17. Preferably the peripheral tube 26 has a bellows-like configuration over much of its length as illustrated in FIG. 5. Intermittent smooth portions 27 are provided along the length of the tube and these smooth portions are adhesively bonded to the web 18 of the male portion of the retractor. The bellows portions 28 between the smooth parts 27 span the intersection between adjacent male and female portions of the retractor and may extend along the entire female portion.

A tube 29 is connected to the peripheral tube 26 and leads to a source of fluid pressure 31. This fluid pressure may be a simple hand squeeze bulb and release valve so that pneumatic pressure may be applied within the peripheral tube 26. If desired the connecting tube 29 can be terminated with a sealing plug through which the needle of a syringe may be inserted. This permits the tube 26 to be inflated with a sterile saline solution, for example, so that in case of rupture of the tube there is no hazard to the patient.

When the inflatable tube is used on a surgical retractor the retractor is inserted in an incision as hereinabove described in a collapsed or retracted state. Fluid is then added to the tube and the inflation causes the bellows portions 28 to extend thereby causing the pieces of the retractor to slide relative to each other and enlarge the retractor. Enlargement of the retractor is thus readily obtained by simple application of fluid pressure. Retraction of the edges of an incision is thereby made easier for the surgical team.

The inflatable tube 26 is on the outside of the retractor and engages the flesh at the edge of the incision thereby cushioning it from the retractor. Typically, sterilizable silicone rubber or the like is used for the inflatable tube. It is preferred that the tube be on the outside of the retractor so as to be remote from the surgical site, thereby providing a greater assurance against accidental puncture of the tube during the course of surgery. When it is desired to remove the retractor from the surgical site the fluid pressure in the tube is relieved and the retractor ratchets collapsed in the same manner hereinabove described.

It will also be apparent that if desired the ratchets can be deleted from the several pieces of the surgical retractor and it can be maintained in its opened position by the fluid pressure alone. In that case gradual release of the fluid pressure permits contraction of the retractor due to the forces of the tissues. Such retraction may be manually assisted if desired. The end and side pieces of the retractor are preferably made by die casting or rubber mold casting of any of a variety of modern plastic or synthetic materials which have already come into wide use in hospitals and other medical practice. Many such materials are readily sterilizable at the time of manufacture and assembly and are then individually packaged, not to be opened until required for surgery. Since such retractors can be made economically, they can be used once and then discarded, thereby obviating cleaning and resterilization.

The choice of plastic materials is also advantageous in providing an appropriate degree of elastic bowing of the side slats when the retractor is used. The shapes of the male and female members forming the side slats are such that substantial changes in section modulus can be made without substantial changes in the overall dimensions of the side slats. If desired, steel strips can be imbedded in the plastic for controlled stiffness and strength. With such possible variations, retractors for symmetrical or asymmetrical opening of surgical sites can readily be provided, and substantial changes in size and the stiffness of the surgical retractor can be made in the course of design for particular applications.

Although limited embodiments of surgical retractor constructed according to principles of this invention have been described and illustrated herein, many modifications and variations will be apparent to one skilled in the art. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A surgical retractor comprising:
 - a first elongated elastic side slat;
 - a second elongated elastic side slat facing the first slat;
 - means for freely extending the length of the first and second slats and resisting contraction thereof; and
 - a V-shaped end piece at least partially elastically deflectible at each end of the retractor connecting each end of the first slat to the respective end of the second slat with mutual divergence of the two slats at each end so that the slats elastically bow in mutually spaced apart arcuate paths between their ends with the concave sides of the slats facing each other.
2. A surgical retractor as defined in claim 1 wherein the means for extending comprises an extensible inflatable tube on the outside of the slats and intermittently connected thereto.
3. A surgical retractor as defined in claim 2 further comprising means for inflating the tube.
4. A surgical retractor as defined in claim 1 wherein each slat comprises a pair of interengaging side pieces

slidable lengthwise relative to each other, and wherein the means for extending comprises:

ratchet means on one of the side pieces and pawl means on the other side piece cooperating for substantially free lengthwise extension and restricted lengthwise contraction.

5. A surgical retractor as defined in claim 4 wherein each of the side pieces comprises a curved transverse web, the two webs having their concave sides facing each other and wherein the ratchet means comprises a plurality of teeth spaced along the length of the concave side of one web and the pawl means comprises at least one tooth on the concave side of the other web for engaging the ratchet teeth.

6. A surgical retractor as defined in claim 5 wherein one of the side pieces comprises a pair of opposed hook-like flanges extending lengthwise along the side edges on the concave side of the lip and wherein the web of the other side piece fits between the flanges.

7. A surgical retractor as defined in claim 5 wherein each of the side slats includes a pair of spaced apart ribs extending along the length thereof for forming a channel for receiving tissue adjacent a surgical incision or the like.

8. A surgical retractor as defined in claim 7 wherein the means for extending further comprises means for slidably extending the side pieces relative to each other in response to increasing fluid pressure.

9. A surgical retractor as defined in claim 8 wherein the means for slidably extending comprises an extensible inflatable tube in the channel and connected to each side piece.

10. An extension side piece for a surgical retractor of the type having at least a pair of side slats interconnected by a pair of end pieces that cause the side slats to mutually diverge comprising:

an elastic slat having a male cross section for about half its length and a female cross section for about half its length;

ratchet means extending along one of the half lengths; and

pawl means on the other half length, said ratchet means and pawl means for cooperating with corresponding pawl means and ratchet means respectively, for substantially free lengthwise extension and restricted lengthwise contraction.

11. An extension piece as defined in claim 10 wherein the female cross section comprises:

a transverse web; and

a pair of opposed hook-like flanges extending along opposite edges of the web; and the male cross section comprises:

a transverse web fittable between the flanges of a female member having a cross section like that of the female half; and wherein the ratchet means is along one web and the pawl means is on the other web.

12. An extension piece as defined in claim 11 further comprising an extensible inflatable tube connected to one face of the elastic slat on one of its half lengths.

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