

[54] **SURGICAL CLIP AND APPLICATOR**

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[51] Int. Cl. **A16b 1/06; A61b 17/08; A61b 17/10**

[58] Field of Search **128/6, 303.15, 321, 325, 128/346**

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Primary Examiner—Channing L. Pace

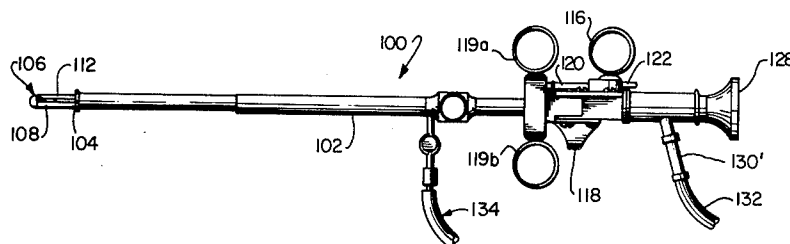
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[57]

ABSTRACT

A surgical clip, particularly adapted to produce necrosis in Fallopian tube tissue, consists of jaws hinged adjacent one end and a U-shaped spring which holds the jaws open in one position and exerts a closing pressure on the jaws in another position. The clip is particularly adapted to be applied to tube tissue, through a laparoscope designed to have a pair of slidable actuators one of which closes the clip jaws and assists in retaining the clip in proper location at the distal end of the laparoscope and the other actuator is adapted to position the U-shaped spring in the jaw closing position.

10 Claims, 11 Drawing Figures



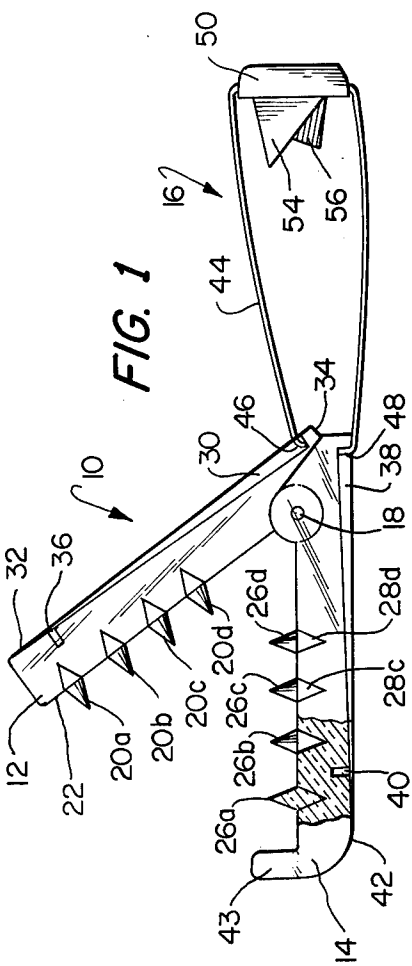
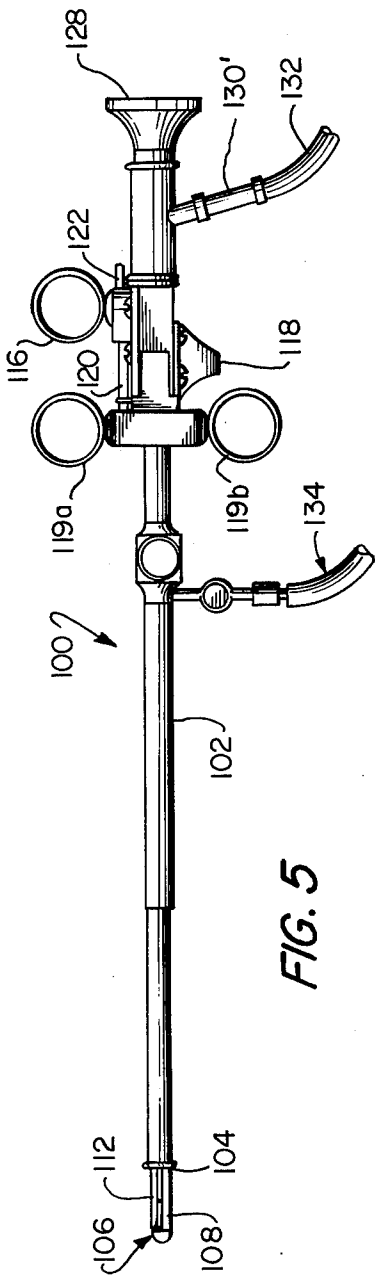
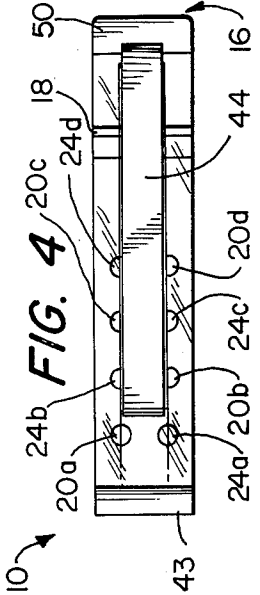
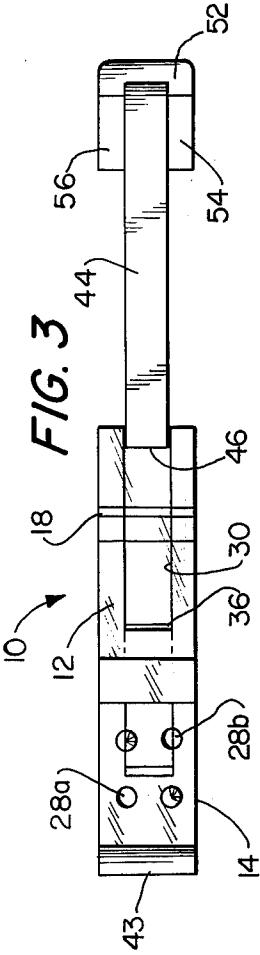
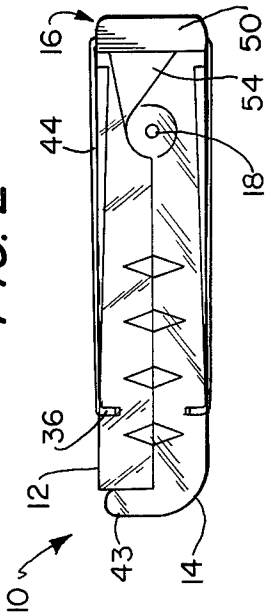


FIG. 2



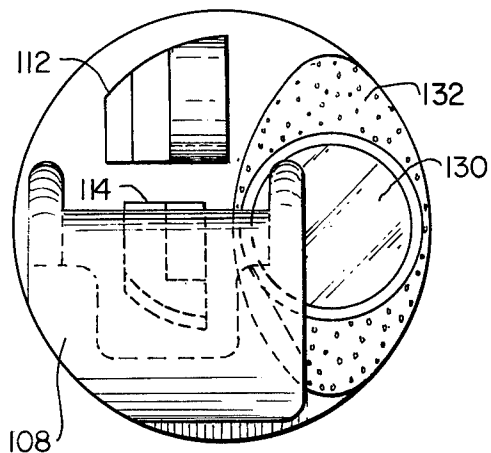


FIG. 6

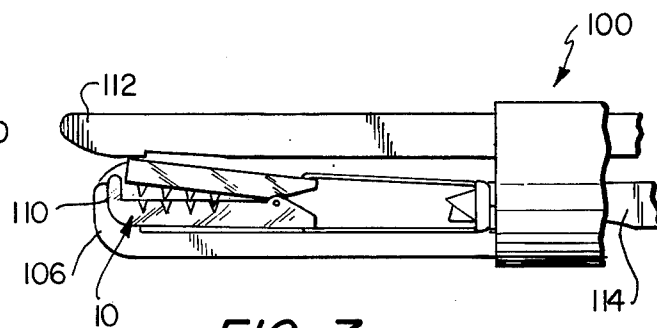


FIG. 7

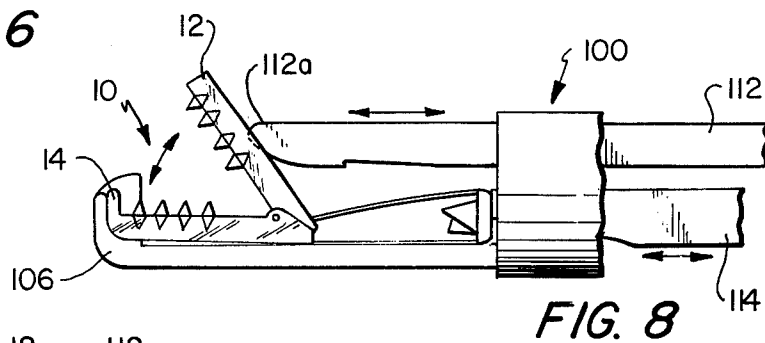


FIG. 8

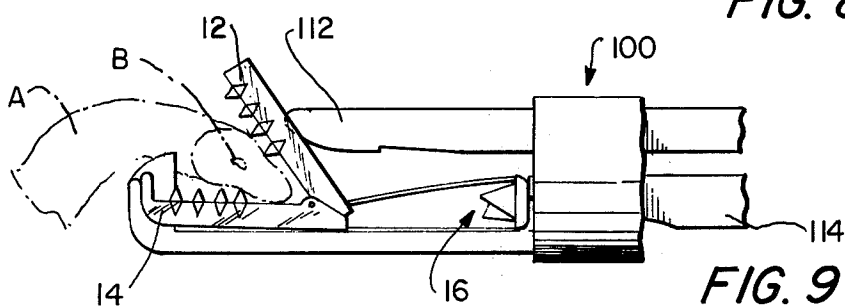


FIG. 9

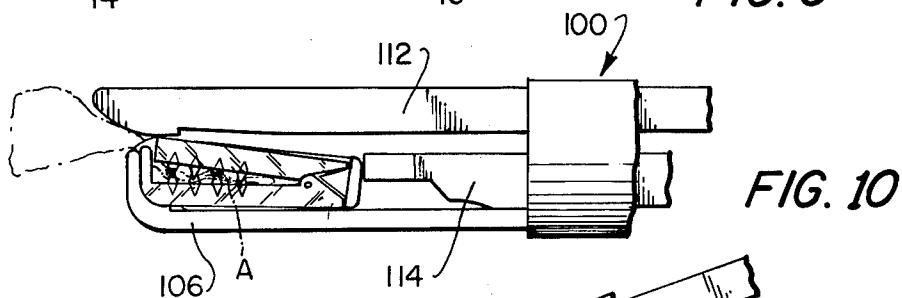


FIG. 10

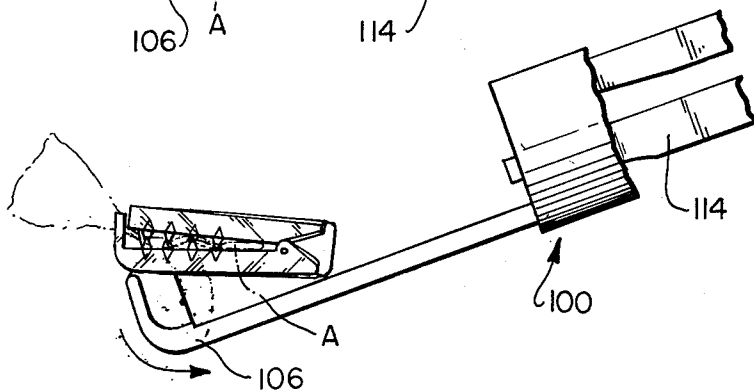


FIG. 11

SURGICAL CLIP AND APPLICATOR

The principal rights to this invention are subject to subsequent assignment to the United States Government.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally appertains to new and useful improvements in clamping devices, especially those designed for closing or shutting off flexible tubular conduits, and is particularly directed to a new and useful clamping instrument for use for occluding Fallopian tubes and other ducts in an animal or a human body.

2. State of the Art

Devices currently available and used for occluding Fallopian tubes are U-shaped clips or clamps. Applied by being inserted over the tubes and then compressed or flattened mechanically to achieve occlusion, they are often difficult and cumbersome to handle and position correctly. If the compression pressure is so strong that the clips are completely flattened, one or both of two possible application failures may occur. First, the tubes may be severed and hemorrhaging occur. Second, since the clips are generally only 1mm wide, if any part of a tube is severed, it can readily bypass the narrow clip, re-anastomose and render the patient fertile once again.

On the other hand, if the mechanical compression pressure on such clips is not strong enough, they will not be completely flattened, thus leaving small openings for the Fallopian tube, sufficient to allow passage of the microscopized ova.

SUMMARY OF THE INVENTION

An important object of the present invention is to provide a hinged jaw type clip or clamp designed such that the upper and lower jaws of the clip are closed down on the Fallopian tube to an open height of 1mm at the forward end of the clip, at which point a light compressive force is applied through a U-shaped spring. This force causes gradual necrosis and dissipation of the tissue between the jaws so that the clip effects a complete closure, upon completion of the necrosis of the tube, both without hemorrhaging and without any open spaces through which live tissue and/or ova could pass.

A further object is to provide such a Fallopian tube clip or clamp having a width of, for example, 3mm and height of about 4mm to reduce to a minimum the possibility that the clamped Fallopian tube will re-anastomose around the clip.

Another object is to provide such a clip and applicator therefor which can be used to perform sterilization on women under local anesthesia and with minimum interference with the patient's occupation or home duties.

In general the clamp of the present invention comprises a pair of cooperating jaw members hinged adjacent one end, a generally U-shaped spring, and means on the remote faces of each jaw member to slidably receive the U-shaped spring in jaws open and jaws closed positions. More specifically, the clip or clamp consists of two Lexan plastic or other body compatible jaws hinged around a stainless steel pin. The clip is held open by a stainless steel U-shaped spring which is gold plated, and is held closed by the same spring when the

spring is pushed over the jaws and exerts pressure on the end of the jaws distal to the hinge. A Silastic filler is attached to the metal spring to fill up all remaining dead space so as to minimize the possibility of infection.

In general the clip applicator comprises a laparoscope adapted to receive the clip at its extended end and a pair of jaw and spring actuating rams. The laparoscope may also include a surgical microscope and a source of light which may comprise a light transmitting fiber optical bundle.

DESCRIPTION OF THE DRAWING

The invention will be more particularly described in reference to the accompanying drawing wherein:

FIG. 1 is an enlarged partial sectional view of an embodiment of a tube clip of the invention with the clip jaws in the open position and being retained therein by a generally U-shaped spring;

FIG. 2 is a view of the clip shown in FIG. 1 with the jaws in the closed position and being retained therein by the U-shaped spring;

FIG. 3 is a top plan view of the structure shown in FIG. 1;

FIG. 4 is a top plan view of the structure shown in FIG. 2;

FIG. 5 is an illustration of an improved laparoscope for use with the clip shown in FIGS. 1 through 4;

FIG. 6 is an enlarged end view of the instrument shown in FIG. 5; and

FIGS. 7, 8, 9, 10 and 11 are diagrammatic fragmentary views of the use of a clip of the invention and modified laparoscope during the application of a clip to a Fallopian tube.

Referring to the drawings and in particular FIGS. 1 through 4, 10 generally designates the improved Fallopian tube clip or clamp. The clip 10 includes an upper jaw member 12, a lower jaw member 14 and a U-shaped spring assembly 16. The upper and lower jaws 12 and 14 of the clip are hinged together by a hinge pin 18 which pin may be made of stainless steel, gold, plastic or other biocompatible material while the jaws 12 and 14 are also formed of a biocompatible material. Lexan plastic has been found to be very suitable, and comprises a thermoplastic polycarbonate resin manufactured by General Electric Company.

The upper jaw 12 is molded or formed with a plurality of depending conical spikes 20a, b, c and d arranged in two rows with spikes 20a and c aligned in one row and 20b and d in opposite row. Further, the surface 22 of upper jaw 12 is provided with four conical bores 24a, 24b, 24c and 24d with bores 24a and 24c being in the same row with conical spikes 20b and 20d and conical bores 24b and 24d being in the same row as conical spikes 20a and 20c as more clearly shown in FIG. 4 of the drawings. The spikes prevent the clip from slipping off the slippery Fallopian tube as the jaws of the clip are closed by the closure tool, and prevent extrusion of the Fallopian tube from the forward end of the clip.

The lower jaw 14 is also provided with alternate spikes and bores spaced and arranged such that when the jaws are closed as shown in FIGS. 2 and 3 spikes in the top jaw engage bores in the lower jaw and vice versa. In the bottom jaw the spikes are designated 26a, 26b, 26c, and 26d and the conical bores in the bottom jaw are designated 28a, 28b, 28c and 28d.

The upper jaw 12 is provided with a groove 30 in its top surface 32 which extends from adjacent to the rear end 34 to a transverse slot 36. The groove 30 and the transverse slot 36 are sized to receive the U-shaped spring 16 to be more fully described hereinafter. A similar groove 38 and slot 40 are formed in the bottom wall 42 of the lower jaw 14 of the clip. Further, the lower jaw 14 is provided with an upstanding end element 43 which as more clearly shown in FIG. 2 assists in providing the closed clip with a relatively smooth contour and assists in retention of a Fallopian tube within the jaws when the jaws are in the closed position.

The U-shaped spring assembly 16 includes a metallic ribbon-like spring 44 having the ends of its legs turned in as at 46 and 48. The width of the spring 44 is such that it is slidably receivable in the grooves 30 and 38 in the respective jaws 12 and 14 and the spring has a thickness so that the turned in ends 46 and 48 may be received in their respective slots 36 and 40 in jaws 12 and 14.

The bridge portion of the U-shaped spring assembly 16 is provided with a fillet or filler element 50 shaped such that when the clamps are closed as shown in FIGS. 2 and 4 the fillet 50 fills in the open space of the hinge arrangement of the pair of jaws to thereby reduce to a minimum zones for the collection of matter which might be the locus of infections. The fillet 50 generally includes a back piece 52 and a pair of generally triangular shaped wings 54 and 56. The fillet may be formed of the same material as used in the formation of the jaws or a dissimilar material.

Referring now to FIGS. 5, 6 and 7, 100 generally designates a laparoscope clip applicator which includes a tubular body portion 102 fitted at its extended end 104 with a headpiece 106 provided with a cradle 108 shaped to receive one of the clips 10 with the hinge end thereof positioned outwardly and the forward end of the clip nested against the curved recess 110 of the cradle 108. The laparoscope includes a pair of rams or applicators 112 and 114 with the ram 112 adapted to retain the clip 10 in its nested position in the cradle 108 and to permit opening and closing of the top jaw 12 thereof while the lower ram 114 is adapted to actuate the U-shaped spring 50 from its retracted position shown in FIGS. 1 and 3 to its closed position shown in FIGS. 2 and 4.

The ram 112 is connected to a slide member 116 at the opposite end of the instrument 100 while ram 114 is connected to its slide member 118. Upper and lower finger engaging stabilizing rings 119a and 119b are provided by the instrument.

In FIG. 5 it will be noted that a latch member 120 for ram 112 actuating member 116 is provided. The latch member 120 cooperates with edge 122 of actuator 116 to prevent accidental withdrawal of ram 112 beyond the position shown in FIG. 8 until the clip has been positively attached to the Fallopian tube to thereby minimize accidental displacement of the clip from its cradle during use of the device. When the clip is fully attached release of the latch member 120 permits withdrawal of the ram 112 so that the clip can be separated from the laparoscope as to be more fully described hereinafter.

The laparoscope also includes a surgical microscope having an eyepiece 128, FIG. 5, and an objective lens 130, FIG. 6. Surrounding the objective lens of the surgical scope is a bundle 132 of light transmitting fibers. The fiber optical bundle 132, as more clearly shown in

FIG. 6, is arranged in an elliptical configuration so that adequate light can be conveyed to the subject without interfering with the clip and clip cradle and without the necessity of using a trocar sleeve for the laparoscope of greater diameter than 10mm as to be more fully described hereinafter.

The laparoscope is also provided with a tap 130' which receives the external fiber optic bundle 132 which is connected to a source of controlled light not shown. The laparoscope also includes the conventional means 134 for directing air or other gases to and from the operation zone.

The length, width and height of the clip would vary depending on the intended use of the clip; however, it has been found where the clip is to be used to occlude Fallopian tubes in adult women, a clip 3mm wide, 4mm high, and having a length of about 16mm and internal jaw lengths of about 1cm has provided very satisfactory results.

Use of the clip and applicator will be described in reference to FIGS. 7 through 11. One of the clips 10 with its spring assembly 16 in the rearward position is placed in the cradle 108 of the laparoscope 100 and after insertion ram or actuator 112 is moved to a forward position so that the clip and forward end of the laparoscope are in the mode shown in FIG. 7. After the instrument is inserted into a trocar, placed in an incision in the patient's abdomen, the ram or actuator 112 is moved rearwardly to the position illustrated in FIG. 8 whereby the jaws 12 and 14 of the clip 10 are in their fully opened position; however, the clip is still retained in the cradle 106 by the presence of the tip 112a of ram 112.

With the clip in this position the surgeon locates the Fallopian tube A with the aid of the microscope and fiber optic lighting system and positions the open-jawed clip about the selected zone of the Fallopian tube having the opening B therein. This aspect of the operation of the device is illustrated in FIG. 9. After the Fallopian tube is properly located between the jaws of the clip 10, ram 112 is urged forwardly to the position shown in FIG. 7 and the Fallopian tube is urged into a collapsed position as shown in FIG. 10. While the tube is in the collapsed position ram actuator 114 shoves the spring assembly 16 forwardly to seat the inwardly curved tips 46 and 48 thereof into engagement in their respective slots 36 and 40 and the fillet member 50 into the space rearwardly of the hinge pivot 18 of the clip. This is shown in FIG. 10.

With the spring securely in place the spring exerts a continuing closing force upon the jaws further constricting the Fallopian tube. Next the latch member 120, FIG. 5 of the drawings, is released and ram 112 is withdrawn from the tip of the laparoscope freeing the clip from its saddle 106 as shown in FIG. 11 so that the surgeon may carefully manipulate the device and proceed to insert a second clip on the other tube of the female patient.

Since the entire instrument is contained within a 10mm trocar it has been found possible to perform the operation while the patient is only under a local anesthetic.

From the foregoing description of the improved Fallopian tube clip and applicator, it will be seen by those skilled in the art that the aims and objects of the present invention are fully accomplished. It will be further recognized that various modifications may be made in

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the form of the clip and its applicator without departing from the scope of the appended claims.

We claim:

1. A surgical clip and actuator for occluding tubes in a living animal said clip comprising first and second jaw members; means adjacent one end of each jaw member pivotally mounting the other ends of said jaw members for movement toward and away from each other; a generally U-shaped spring member engaging remote surfaces of each jaw member and slidable from a first position on one side of the said pivotal mounting, to urge said jaw members into the open arrangement, to a second position on the other side of the said pivotal mounting, to urge said jaw members into the closed position; and said actuator including a cradle for said clip and first and second manually operable rods; said first rod adapted to contact a top surface of said first jaw member and to urge said jaw member toward said second jaw member against the urging of said U-shaped spring when said spring is in said first position; and said second rod positioned to urge said U-shaped spring into said second position.

2. A surgical clip for occluding tubes in a living animal comprising first and second jaw members; means adjacent one end of each jaw member pivotally mounting the other ends of said jaw members for movement toward and away from each other; a generally U-shaped spring member engaging remote surfaces of each jaw member and slidable from a first position on one side of the said pivotal mounting, to urge said jaw members into the open arrangement, to a second position on the other side of the said pivotal mounting to urge said jaw members into the closed position.

3. An actuator for a surgical clip comprising an elongate tubular body portion, a clip receiving cradle having a bottom wall and an end wall extending longitudinally from one end of the tubular body, first and second manually operable rods mounted in said tubular body

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and for reciprocation relative thereto, said first rod having an actuating head positioned in a plane immediately above the cradle and reciprocal in said plane over said cradle, a first actuating member mounted at the opposite end of the first rod at the end of the tubular body remote from the cradle, said second rod having an actuating head aligned with said cradle and movable immediately over the bottom wall of the cradle, and a second actuating member mounted at the opposite end of the second rod at the end of the tubular body remote from the cradle.

4. A surgical clip as defined in claim 2 wherein the opposed surfaces of each jaw member are provided with a plurality of opposed interfitting tube gripping elements.

5. The invention defined in claim 4 wherein said opposed alternate interfitting elements comprises cooperating cones and conical bores.

6. The invention defined in claim 4 wherein said generally U-shaped spring member is of ribbon configuration and the remote faces of the jaw members are provided with elongated slots within which the ribbon-like U-shaped spring is adapted to slidably traverse.

7. The invention defined in claim 6 including turned in tip elements on said U-shaped spring and cooperating transverse slots in said grooves of each jaw member to secure the U-shaped spring when said spring is in the position to urge the jaw members into their closed position.

8. The invention defined in claim 3 wherein said tubular body includes a surgical microscope and a source of light therefor.

9. The invention defined in claim 8 wherein said light source includes a bundle of light transmitting fibers.

10. The invention defined in claim 9 wherein said light transmitting bundle of fibers are arranged in an oval configuration.

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