

- [54] **BOX-LOCK SPANNER SPRING**
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- [22] Filed: **Dec. 24, 1970**
- [21] Appl. No.: **101,207**
- [52] U.S. Cl. **72/410, 227/19**
- [51] Int. Cl. **B21d 9/08**
- [58] Field of Search 81/417, 427; 227/19; 128/325; 72/410; 29/212

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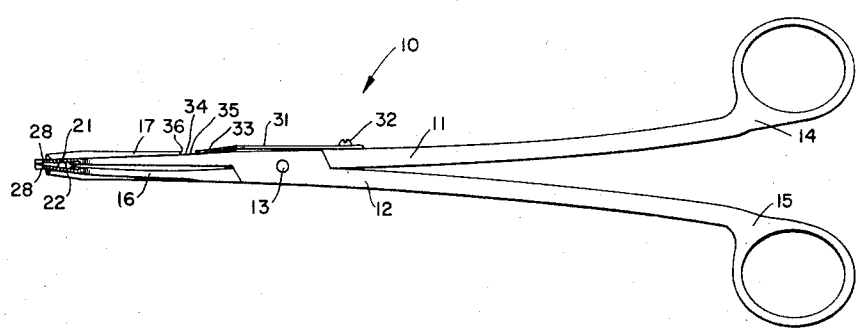
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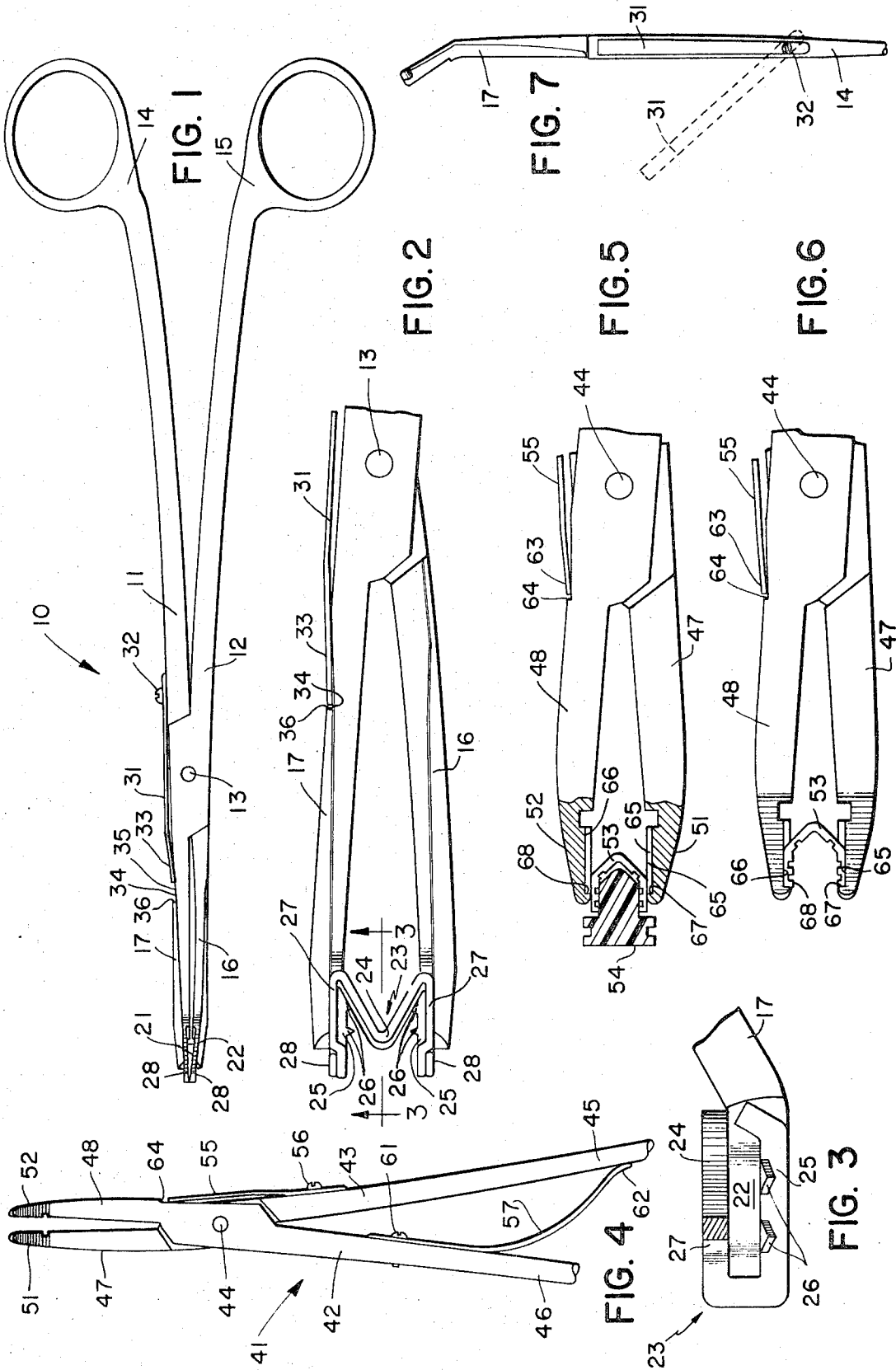
[57] **ABSTRACT**

A surgical instrument of the forceps type having an improved biasing means. A leaf spring is mounted so as to span the forceps hinge and urge the jaws toward either an open or a closed position. The biasing means also governs the precise amount of opening normally permitted between the applicator jaws. A second embodiment employs a second spring acting in combination with the spanning spring to maintain the jaws normally open by a predetermined distance.

7 Claims, 7 Drawing Figures

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BOX-LOCK SPANNER SPRING**FIELD OF THE INVENTION**

This invention relates in general to surgical instruments of the forceps type and more particularly involves instruments which are used for the application of surgical clips for such purposes as strangulation of flexible tubular members or for clip type skin sutures.

DISCUSSION OF THE PRIOR ART

Surgical instruments comprising a pair of hinged members are used for a multitude of purposes and are made in many configurations for various specific uses. Such instruments may act in diverse ways, some directly such as clamps, forceps and scissors, while others act indirectly in that they are used to apply, remove or otherwise act upon another surgical device. Forceps type surgical instruments may be used for applying or removing clips for suturing skin wounds, for applying or removing other types of clips for strangulation of fluid ducts in the human body, or for use with hemostats and other instruments and devices.

It is often desirable to provide some type of biasing means on instruments of the type mentioned in order to urge them toward either an open or closed position or to urge them to some intermediate position to provide a specific desired opening of the jaws under normal conditions. This has conventionally been done by means of a spring device operating between the pivoted elements of the instrument on the handle side of the pivot. One such device is shown in U.S. patent application Ser. No. 832,947, now U.S. Pat. No. 3,631,707, owned by the same assignee as the present invention. That application discloses the use of a curved leaf spring attached to one handle member and biasing the other handle member away from it, thus tending to open the instrument jaws. In order to prevent opening of the instrument beyond a desired amount, the spring in the application referred to has an opening or eye in the non-attached end, which opening is adapted to engage a hook element attached to the other handle member. The biasing spring thus prevents the instrument from opening beyond the desired amount. However, since the spring is intended to bias two members away from one another, the additional use employing the hook and eye, while fully operable, utilizes the spring for two purposes, one of which is different from the purpose for which it was constructed. Other instruments may have biasing means which employ a rod attached to one handle member and extend through the other handle member with a coil spring on the rod on one side of the other handle member to bias the handles toward or away from each other.

The reasons why it may be desired to bias such an instrument into an open position, a closed position, or a specific intermediate position will become apparent from the detailed description hereinbelow.

SUMMARY OF THE INVENTION

Broadly speaking, this invention comprises a leaf spring pivotally attached to one handle member and spanning the pivot area (normally termed a box lock) so that the other end contacts the other handle member forward of the pivot. The leaf spring specifically described herein is slightly bowed toward the instrument in order to provide the biasing necessary to urge the jaws of the instrument toward the closed position. A

notch is provided in the second member for the purpose of preventing the jaws from opening beyond a predetermined precise distance. The end of the spring abuts the shoulder of the notch when the jaws are opened to this distance to thereby prevent further opening thereof.

This structure has several advantages over prior art biasing devices. It is extremely simple and uses a minimal amount of material for the biasing means. The spring operates as intended, to bias the jaws toward a closed position, and the notch prevents the spring from being over extended or in any way used in a manner different from its primary purpose. Additionally, the spring is pivotable so that its effect upon the instrument may be negated by swinging it out of the way. This allows the instrument to be easily cleaned or adjusted as desired. By using springs of different strength and by varying the amount of bend in it, the amount of bias may be adjusted to any practical degree.

It should be recognized that by reversing the direction of bend in the spring and suitable modifying the forceps at the spring mounting location that the spring may urge the jaws apart. The principles of the invention are the same and this specification will describe only the bias means which urges the forceps jaws toward the closed position.

BRIEF DESCRIPTION OF THE DRAWING

The features and advantages of this invention will be readily understood when the detailed description thereof is read in conjunction with the drawing wherein:

FIG. 1 is a plan view of a skin suture clip applicator constructed in accordance with this invention;

FIG. 2 is an enlarged partial view of the applicator of FIG. 1 showing the skin suture clip held between the jaws thereof;

FIG. 3 is a further enlarged sectional view taken along cutting plane 3—3 of FIG. 2 showing the clip as engaged by the jaws of the applicator;

FIG. 4 is a partial plan view of a hemostatic clip applicator which uses a dual biasing means to hold the jaws in an intermediate open position;

FIG. 5 is an enlarged partial view of the applicator of FIG. 4 in the process of engaging a hemostatic clip, the jaws of the applicator being in section for clarity;

FIG. 6 is a view similar to FIG. 5 fully engaging the hemostatic clip; and

FIG. 7 shows how the spring of this invention may be pivoted away from its normal operating position to enable full opening of the jaws of the instrument.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the drawing, and more particularly to FIGS. 1, 2, and 3 thereof, there is shown a forceps type surgical instrument 10 particularly adapted for the application and removal of skin suture clips. The applicator comprises member 11 pivotally connected to member 12 by means of pivot pin 13. Pivoted members 11 and 12 have handle portions 14 and 15 on one side of the pivot and respective jaw portions 16 and 17 on the other side of the pivot. The type of pivot shown is normally termed a box lock and is commonly used with surgical instruments. The jaw members of instrument 10 are formed with flat facing portions 21 and 22 which are adapted to hold suture clip 23 as shown

in FIGS. 2 and 3. When the jaws are manually opened sufficiently to engage the suture clip, jaw facing portions 21 and 22 are substantially parallel to one another to thereby enable firm engagement with the parallel sides of the clip for positive retention thereof.

The suture clip is formed with an M-shaped portion 24 in one plane and arms 25 in a second plane spaced therefrom. Arms 25 are formed with spicules 26 for engaging the skin upon being applied for suturing purposes. Arms 25 are indented inward somewhat from the outer edges of legs 27 of the M-shaped portion of the suture clip, thereby providing two surfaces normal to one another along each side of the clip. Jaws 16 and 17 are adapted to fit in the corners formed by these normal surfaces for registration with the clip, flat portions 21, 22 contacting the outside surfaces of arms 25. Jaws 16, 17 are provided with tips 28 of reduced cross section. These tips are adapted to fit between the legs 27 of a closed suture clip in order to open it for purposes of removal.

The jaws of the applicator are biased toward the closed position by means of leaf spring 31 which is pivotally attached at one end to handle portion 14 of member 11 by means of screw 32, while the other end 33 engages jaw portion 17 of member 12. Spring 31 is bent slightly as shown in the drawing and is of sufficiently heavy material so that the jaws of instrument 10 are normally biased toward the closed position. The jaws may be opened by applying forces at handles 14 and 15 to separate them, thereby acting in opposition to the biasing force of spring 31. By sufficiently opening jaws 16 and 17, suture clip 23 may be engaged as shown in FIG. 2. It is contemplated that such clips will be held in a cartridge or magazine, not shown, for ready access by an instrument such as applicator 10. By thus engaging suture clip 23 and then releasing the separating force from the handles, the clip is positively engaged by frictional forces between opposed faces 21 and 22 and may be easily removed from the cartridge for use in suturing a wound. Because spring 31 maintains a substantial force tending to close jaws 16 and 17, these jaws maintain positive hold in clip 23 absent a counter-acting force tending to separate handles 14 and 15. The clip is then applied by placing it so that the wound is between arms 25 and then forcing handles 14 and 15 together until spicules 26 properly engage the skin on either side of the wound.

The outer surface of jaw 17 is formed with a notch or undercut 34 as is clearly shown in FIGS. 1 and 2. Thus undercut has several specific purposes. The outer surface of the jaw of such an instrument, as well as the outer surface of the handles thereof, are normally somewhat rounded. In order for spring 31 to operate properly, there should be provided a flat surface 35 upon which its forward end may longitudinally slide as the jaws open and close. A flat surface is therefore cut into the side of jaw 17, the end of the flat surface being defined by shoulder 36. Jaws 16 and 17 may be opened only a predetermined distance before end 33 of spring 31 abuts shoulder 36 thereby preventing further opening thereof. Without undercut 34, it is possible that the instrument could be opened sufficiently far to deform or destroy spring 31, thereby making the instrument useless for its intended purposes. The undercut thus allows the spring to operate as intended and at the same time prevents the instrument from being opened sufficiently wide to impair the useful life of the spring.

The undercut is normally slightly deeper than the thickness of end 33 of spring 30 so that the end of the spring is at least flush with the outside surface of the jaw and never projects beyond it. With this construction, there is no danger that the spring might catch on something such as clothing or the patient's tissue when the instrument is being used for surgical purposes.

Screw 32, while securing the spring 31 to member 11 of the instrument allows the spring to be pivoted away from its position of engagement with jaw 17 as shown by the dotted line position in FIG. 7. This enables the instrument jaws to be separated fully for purposes of cleaning the opposing faces and also allows the area between the spring and the box lock to be easily cleaned.

A different type of instrument constructed in accordance with the present invention is shown in FIGS. 4, 5, and 6. This instrument is a hemostatic clip applicator similar to that shown in Application Ser. No. 832,947 previously identified. Instrument 41 includes pivoted members 42 and 43 rotatably secured together by pivot pin 44. Handle portions 45 and 46 are formed with respective jaw portions 47 and 48. The jaw portions are formed with respective lip portions 51 and 52 which are adapted to engage and retain a hemostatic clip 53 as shown in FIGS. 5 and 6. Clip 53 is normally mounted on a cartridge or magazine 54, thereby making the clip readily accessible for engagement by the jaws of instrument 41.

The hemostatic clip applicator of FIG. 4 is provided with a leaf spring 55 similar to spring 31 of instrument 10. This spring is pivotally secured to member 43 by means of screw 56 and engages jaw portion 48 of member 42 to bias the jaws toward the closed position.

A second spring 57 is provided to urge the handles, and consequently the jaw portions, apart. Spring 57 is pivotally secured to member 42 by means of screw 61 and is formed in such a way that end 62 of the spring contacts handle member 45 in a surface-to-surface relationship. The instrument is normally in the condition shown in FIG. 4, that is, the jaws are slightly open, being in an equilibrium position due to the cooperating biasing effects of springs 55 and 57.

In order to engage a clip 53 between lips 51 and 52, the instrument is held neutrally, that is, without any closing or opening forces on the handles, and is forced against the back of the V-shaped portion of the clip. This causes the jaws to separate so that the lips may ride over the parallel sides of the clip as shown in FIG. 5. At this point, end 63 of spring 55 is forced against the shoulder formed by undercut 64 and the jaws are at their maximum normal opening permitting a force fit between the legs of the clip and the jaws. Actually the jaws must spring open slightly greater than the opening readily allowed by spring 55 when the clip is being engaged. When the clip is fully engaged by the lips 51 and 52 as shown in FIG. 6, the parallel arms of the clip reside in recessed grooves 65 and 66 of the lip portions and the clip is positively maintained in place between the applicator jaws by the biasing pressure of spring 55 and by the blind ends 67 and 68 of grooves 65 and 66 respectively. In this condition, end 63 of spring 55 is closely adjacent the shoulder formed by undercut 64, sufficiently close to prevent unintended opening of the jaws which would thereby permit clip 53 to drop out of the instrument. The gap between end 63 of the spring and the shoulder of the undercut is shown exaggerated in FIGS. 5 and 6. The end of the spring will tightly abut

shoulder 64 during engagement with the clip as shown in FIG. 5 and ideally, there should be substantially no gap or only a very slight one to insure that the jaws cannot easily be opened to allow the clip to fall out after engagement as shown in FIG. 6. In this condition end 62 of spring 57 will be separated from handle 45 and will have no effect upon the operation of the instrument. When the clip is applied to a flexible conduit such as a blood vessel, the handles are forced together to close the clip to thereby strangulate the vessel. When the handles are then released, spring 57 forces them apart and completely disengages lips 51 and 52 from the clip.

Besides operating to limit the precise opening between the jaws of the hemostatic clip applicator, spring 55 and its associated undercut 64 have advantages similar to those enumerated for instrument 10. Both spring 55 and spring 57 on instrument 41 may be pivoted away from engagement with members 42 and 43 respectively to enable complete cleaning of the instrument.

When the free end of the hinge spanning springs of both instruments 10 and 41 abut the shoulder at the end of the undercut, the spring is substantially flat or bowed slightly inward. By preventing the spring from bowing outward, the spring cannot be damaged by forcefully separating the handles because the spring can only bow inward so as to lie along the outer surfaces of the box lock. Because it is made of relatively heavy spring material, it simply provides a positive stop and cannot be damaged by separating the handles in any normal manner.

In order to prevent either spring 31 or spring 55 from unintentionally moving from its normal operative position as shown in FIGS. 1 and 4 respectively, a minor modification may be employed. A small indentation may be provided in the flat outer surface (such as surface 35) of the jaws portion and a dimple protruding downwardly may be provided in the spring near its forward end. The dimple will normally engage the indentation and positively maintain the spring in its normal position. Alternatively, two low walls could extend rearwardly from the shoulder on either side of the flat surface to bracket the end of the spanning spring in place. Spring 57 will normally have a concave shape where it slidably engages the handle of the instrument so that it remains where intended.

Having described the preferred embodiments of the present invention, many alternations and modifications will likely occur to those skilled in the art. For example it is apparent that the springs shown in either embodiment may be attached to either pivoted member. In the FIG. 4 embodiment, both springs may be attached to the same member. Also it is possible that a box lock spanning leaf spring may also be constructed so as to urge the instrument jaws to an open position. Furthermore, many different types of clips or other instruments may require the use of a similar leaf spring arrangement as shown in the two embodiments herein which will require suitable modifications to the jaw configurations but still employ the present invention.

What is claimed is:

1. A surgical instrument comprising:

a first elongated member formed with a handle portion and a jaw portion;

a second elongated member formed with a handle portion and a jaw portion;

means for pivotally connecting said first and second elongated members together intermediate their respective handle and jaw portions so that said handle portions may be cooperatively manipulated to open and close said jaws;

elongated first biasing means having a first end pivotally secured to one of said elongated members and extending across said pivot means, a second end thereof engaging the other of said elongated members thereby biasing said jaws in a first predetermined direction relative to each other, the other of said elongated members being formed with an undercut on its outer surface having a shoulder adapted to abut the second end of said leaf spring to thereby positively prevent said jaws from being opened more than a predetermined distance;

said first biasing means comprising a leaf spring which is substantially flat when said second end thereof abuts said shoulder, thereby preventing said leaf spring from bowing outward when the handles of said surgical instrument are forced apart.

2. A surgical instrument comprising:

a first elongated member formed with a handle portion and a jaw portion;

a second elongated member formed with a handle portion and a jaw portion;

means for pivotally connecting said first and second elongated members together intermediate their respective handle and jaw portions so that said handle portions may be cooperatively manipulated to open and close said jaws;

elongated first biasing means having a first end pivotally secured to one of said elongated members and extending across said pivot means, a second end thereof engaging the other of said elongated members thereby biasing said jaws in a first predetermined direction relative to each other, said first biasing means comprising a leaf spring, the other of said elongated members being formed with an undercut on its outer surface having a shoulder adapted to abut the second end of said leaf spring to thereby positively prevent said jaws from being opened more than a predetermined distance;

second biasing means having a first end pivotally secured to one of said handle portions and a second end adapted to engage the other of said handle portions, said second biasing means urging said jaws in a second predetermined direction opposite to said first predetermined direction relative to each other;

said first and second biasing means cooperating to maintain said jaws in an intermediate open position, said first and second biasing means opposing motion of said jaws in either direction.

3. A surgical instrument comprising:

a first elongated member formed with a handle portion and a jaw portion;

a second elongated member formed with a handle portion and a jaw portion;

means for pivotally connecting said first and second elongated members together intermediate their respective handle and jaw portions so that said handle portions may be cooperatively manipulated to open and close said jaws; and

a relatively straight leaf spring having one end pivotally mounted to the outer edge of one of said elon-

gated members and extending generally longitudinally of said instrument across said pivotal connection, the other end of said leaf spring slidably engaging the outer edge of the other of said elongated members thereby biasing said jaws in a first predetermined direction relative to each other, the other of said elongated members being formed with a shoulder on said outer edge facing toward said leaf spring, the other end of said leaf spring abutting said shoulder with endwise contact when said jaws are opened so as to cause said leaf spring to slide toward said shoulder, said leaf spring thereby cooperating with said elongated members to provide a positive stop when said jaws are opened by a predetermined distance.

4. The surgical instrument recited in claim 2 wherein said jaw portions are configured to cooperatively act to engage a surgical device, said surgical device being retained by said jaws due to the biasing action of said first biasing means.

5. The surgical instrument recited in claim 2 wherein: said first biasing means comprises a leaf spring biasing said jaws toward a closed position; said second biasing means comprises a leaf spring biasing said jaws toward an open position.

6. The surgical instrument recited in claim 5 wherein: the jaw portion of said other elongated member is formed with said undercut, said undercut providing

an elongated flat surface and a shoulder substantially normal thereto, said shoulder facing rearwardly toward the handle portion of said other member, said first leaf spring being pivotally secured to the handle portion of said one elongated member;

the second end of said first leaf spring is slidable along said flat surface on said other elongated member and is adapted to abut said shoulder upon opening said jaws a predetermined distance;

said first leaf spring normally continuously biases said jaws toward a closed position, said second leaf spring biases said jaws toward an open position when said jaws are in said intermediate open position and when said jaws are moved toward a position more closed than said intermediate open position, said second leaf spring having no effect upon said surgical instrument when said jaws are opened substantially beyond said intermediate position;

the biasing effects of said first and second leaf springs being equal and opposite in effect when said jaws are in said intermediate open position.

7. The surgical instrument recited in claim 2 wherein said first and second leaf springs are pivotable out of engagement with their respective other elongated members to permit unhindered full closing and opening of said jaw portions.

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