United States Patent [19]

Kletschka

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[45] **Feb. 18, 1975**

[54] **CARDIOVASCULAR CLAMPS**

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Related U.S. Application Data

[63] Continuation of Ser. No. 664,894, Aug. 28, 1967, abandoned.

[52] **U.S. Cl.** **128/322,** 128/346

[51] **Int. Cl.** **A61b 17/28**

[58] **Field of Search** 128/321-346

[56] **References Cited**

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V. Mueller & Co. Surgical Catalogue, Copyright 1956, (1) page 196, FIG. BE-730, (2) page 124, FIG. RH-2300, (3) page 547, FIG. SU-7030, (4) page 177, FIG. MO-1460.

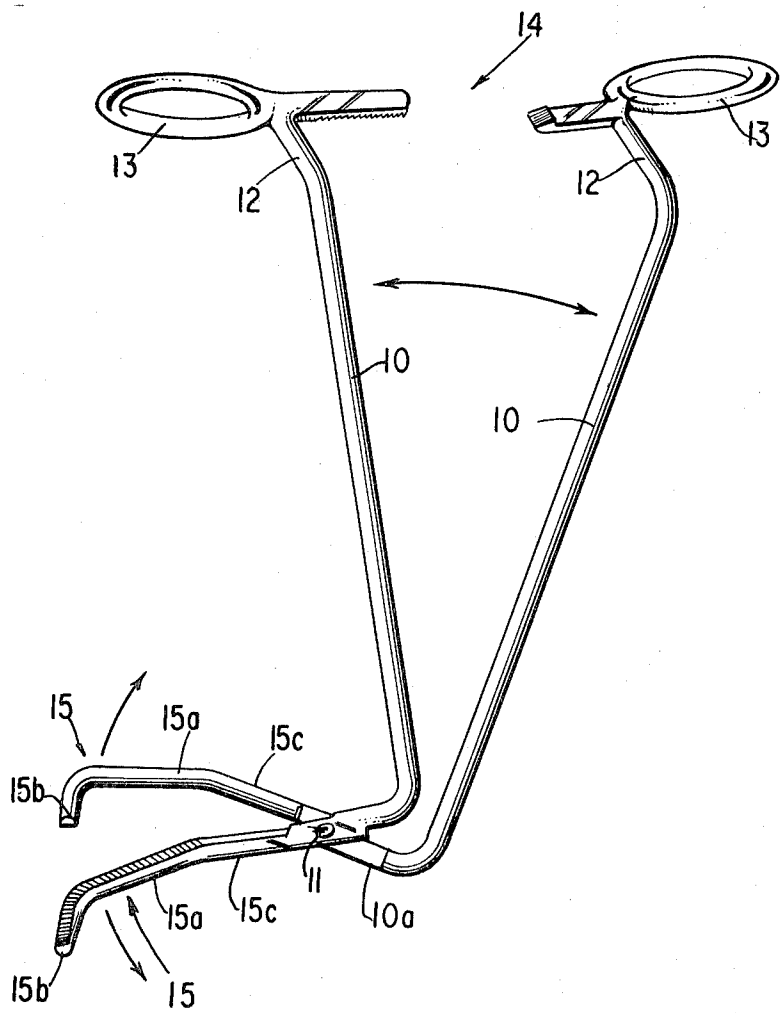
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[57] **ABSTRACT**

This invention relates to cardiovascular clamps for use in various surgical applications so constructed that they may be applied to the arteries or veins of a patient in such manner that little or no strain is placed upon the clamped tissue, and when so applied, the handle portion of the clamp is positioned in such manner that it does not compromise the surgical exposure.

In order to achieve these results, clamps are provided in accordance with the present invention in which the handles open in a plane opposite to that of the occluding jaws, thus resulting in three dimensional operation with respect to the planes of action of the clamp, as opposed to the two dimensional design with clamps presently known to the art.

13 Claims, 7 Drawing Figures



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SHEET 1 OF 2

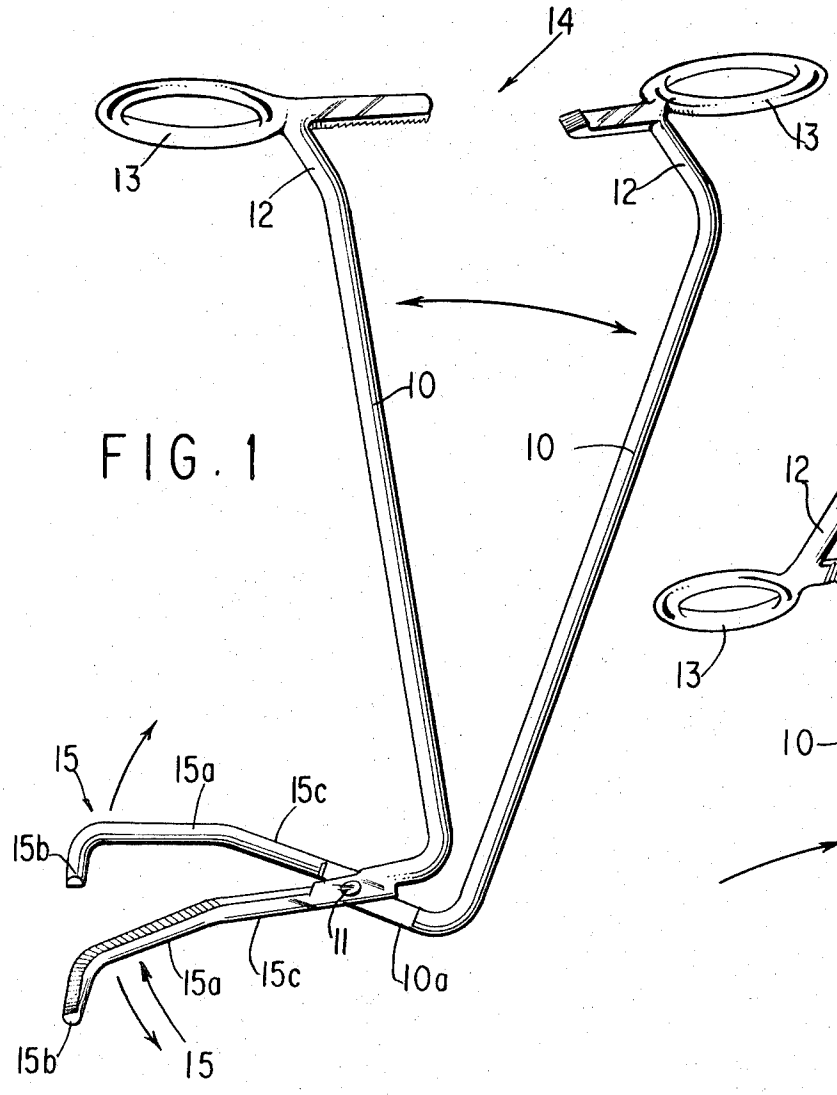


FIG. 1

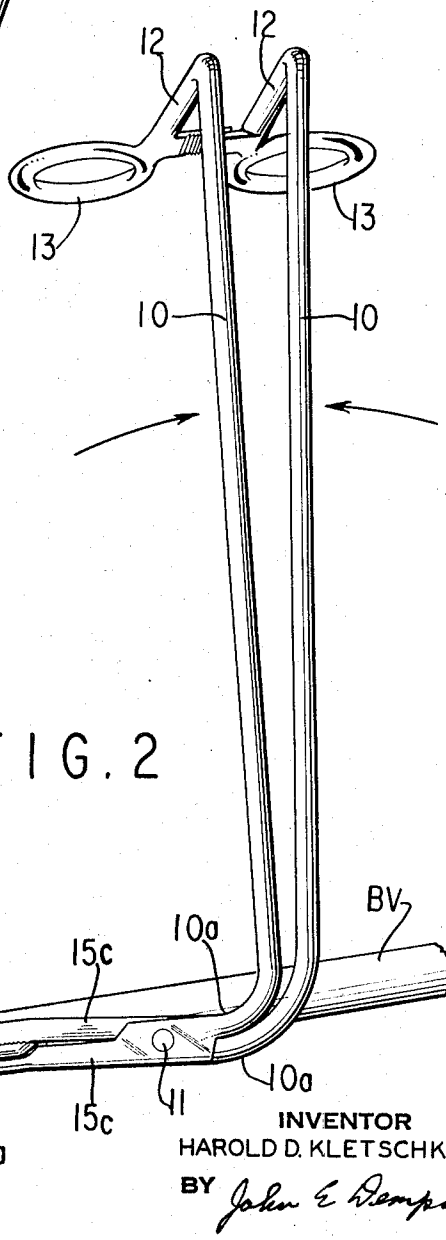


FIG. 2

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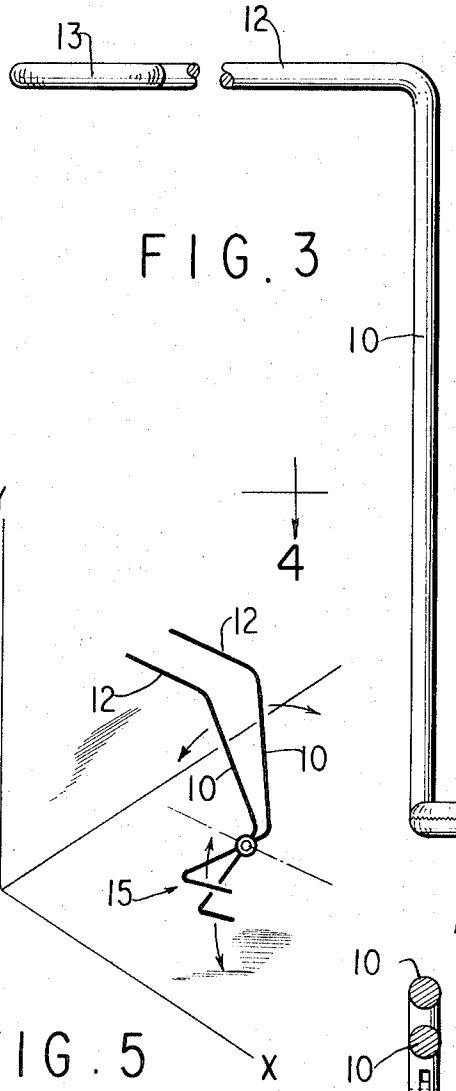


FIG. 3

FIG. 5

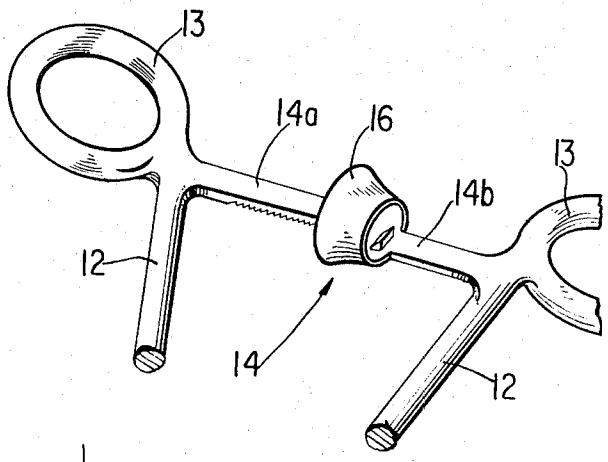


FIG. 6

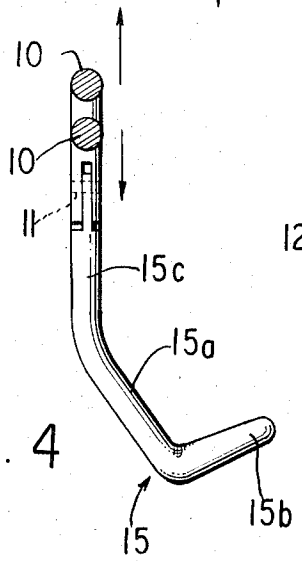


FIG. 4

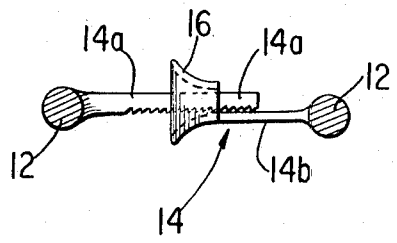


FIG. 7

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CARDIOVASCULAR CLAMPS

This application is a continuation of application Ser. No. 664,894, now abandoned.

DETAILED DESCRIPTION

This invention relates broadly to clamps suitable for use in various surgical applications, and more specifically to clamps so constructed that they may be applied to the arteries or veins of a patient in such manner that little or no strain is placed upon the clamped tissue, and the handle portion of the clamp is positioned in such manner that it does not intrude upon the surgeon's working area.

Surgical clamps presently available are subject to several deficiencies in design which adversely affect the utility of such clamps, particularly in delicate aortal surgery. For instance, in the clamps commonly employed, the handles open in the same plane as the occluding jaws. This results in a serious problem, particularly when the blood vessel is located deep within a cavity (e.g., the aorta within the abdomen). In such a situation there is no good place to position the handles when the clamp is applied so as to exclude the side of the vessel. The handles, therefore, must either (1) remain in the cavity, where they can seriously injure surrounding tissue, (2) protrude from the wound, which results in an undesirable torque being applied to the clamped vessel, sometimes causing rupture of the vessel or surrounding attached vessels, with consequent hemorrhage, or (3) a separate wound is necessitated through the flank of the patient to permit the handles and shaft to be placed so that they can rest comfortably without torque or tension. This last solution is avoided whenever possible for obvious reasons.

In addition, when the handles of available clamps are positioned so that they protrude from the wound, the design of those clamps require that they protrude in an end-on direction. Thus they are subject to inadvertant end-on trauma which is transmitted directly to the occluded vessel and may result in serious injury. In addition, the protruding handles provide a ready trap for the snarling of suture materials, etc., while working, and occupy an appreciable portion of the operative wound, thus compromising the surgical exposure, limiting both vision and working space.

The principal object of the invention, therefore, is the removal or minimization of the above-described deficiencies.

More specifically, an object of the invention is the provision of surgical clamps, the handles of which open in a plane opposite to that of the occluding jaws, and lie flat on the surface of the patient at a distance from the operative wound.

The manner in which the objects of the invention are realized and the principles and advantages thereof will be apparent to those skilled in the art from the description of preferred embodiments of this invention.

Referring to the drawings:

FIG. 1 is an opened frontal view of a clamp of this invention illustrating the manner in which the handles, shaft and jaws operate in different planes.

FIG. 2 is a view showing the operation of the clamp in isolating a portion of a blood vessel.

FIG. 3 is a side view of the clamp with the jaws in gripping position.

FIG. 4 is a sectional view taken along line 4—4 of FIG. 3.

FIG. 5 is a schematic showing the relationship of the planes of action of the clamp to the X–Y planes.

FIGS. 6 and 7 are fragmented views illustrating a form of ratchet locking device preferred for use in the clamps of the present invention. The device is shown in open and closed positions, respectively.

Clamps provided in accordance with the present invention may be of conventional construction insofar as the materials of construction, finish, types of occluding surfaces, size, degree of ruggedness, etc. Size, as in currently available cardiovascular clamps, will vary with contemplated use. Likewise, variations in the relative size of the several parts of the clamps, such as the length of occluding jaws, will vary as in the clamps presently in use. In the same manner, the type of occluding surfaces employed will depend upon the use to which the clamp will be put. Such considerations form no part of this invention and will therefore not be considered in detail, the manner of varying such features being well recognized in the art.

FIGS. **1**, **2** and **3** illustrate clamps comprising two lever arms which are pivoted on pivot **10** **11** the lever arms R provided with handle members or manipulating members **12** ending in finger-receiving rings **13** shaft portions **10**, pivot sections **10***a* and jaw members **15**. Handle members **12** are additionally provided with a locking device indicated at **14**. It is contemplated that, preferably, shaft members **10** will be bent as closely as possible to pivotal connecting means **11**, thus rendering pivot sections **10***a* as short as possible. However, considerations of use may dictate that pivot sections **10***a* in some instances be longer. It will be understood, therefore, that the invention is applicable to such variance. The locking device illustrated comprises inter-engaging toother projections, but it will be understood that any locking device normally employed in such clamps will be suitable for use with the clamp of the present invention. Further, although the locking device is illustrated in the preferred position immediately adjacent the finger-receiving rings at the end of the handle members **12**, it will be understood that such locking device may be positioned at any desired point along the length of the handle members or shaft members.

The illustrated jaw sections **15** are each provided with a first portion **15***a*, adapted to extend substantially longitudinally or axially with a blood vessel or the like (for instance, as shown in FIG. **2**). A second or forward portion **15***b* extends upwardly and forwardly with respect to the first portion **15***a*, and a third or rearward projection **15***c* extends upwardly and rearwardly from each first portion **15***a*.

It will be understood, however, that the specific design of the jaw sections per se do not form an essential part of this invention, and therefore that jaw section **15** may be of any conventional shape and occluding type normally employed for cardiovascular surgery. For example, the forward portions **15***b* may be omitted in clamps to be employed simply for such purposes as crossclamping a blood vessel or other cardiovascular structure.

The handles or other manipulating means, illustrated for convenience in these Figures as terminating in finger-receiving rings, may in practice be of various types, including springs, wedges, cam devices, screws or the like for the purpose of closing or adjusting the jaws.

FIGS. **6** and **7** illustrate a preferred type of locking device which, in view of the three dimensional nature

of the planes of action of clamps of the present invention, ensures added stability and lessens the chance of slippage in use. This device comprises inter-engaging toothed members **14***a* and **14***b* attached to handle members **12**. In addition, attached to toothed member **14***b* in a position to receive the opposite member **14**a, is a conical frustrum-shaped member **16** adapted to guide the opposing members **14***a* and **14***b* into a position suitable for engagement.

It will further be understood that, since it is contemplated that the clamps provided by this invention will be employed in a variety of cardiovascular applications, the various angles to be employed may be widely varied according to contemplated use and still retain the benefits of the novel concept of this invention.

Thus, the angle at which the manipulating members **12** connect with shaft members **10** would range between about 25° and 155° to encompass the clinically useful area of action, while the range of angles most usually employed would be between about 45° and 135°. The most preferable angle, which might be employed in the largest variety of surgical procedures, would be about 100° when the manipulating members extend in the same direction (with reference to the plane of movement of the shaft members) to that of jaw members **15***a*, and about 80° when they each extend in the opposite side of the plane of movement the shaft members.

The angle between shaft members **10** and pivotal connecting means **11** likewise may vary between a range of from about 30° to 150° preferably about 45° to 135°, most preferably being about 70° to 100°.

The angle at which jaw member **15***a* is preferably deflected from the plane of action of pivotal connecting means **11** may be varied over a range of from about 15° to 165°, more preferably about 45° to 130°, with the most preferred angle being about 75°.

Although, as noted above, the manipulating means may, and preferably are, positioned in either side of the plane of action of the shaft members, positioning of the manipulating means within the plane of action of the pivotal connecting means is also contemplated, so long as the manipulating means are positioned such that they are in apposition one to the other, that is, such that movement of the manipulating means in opposite directions one from the other, results in corresponding opening and closingof the jaw members.

It will, of course, be understood that when the manipulating means are at an angle other than 90° to the plane of action of the pivotal connecting means, the locking means will be angled or curved so as to remain in alignment during the operation of the clamp.

From a consideration of FIGS. 1 to 7, it can readily be seen that the novel clamps of the present invention completely overcome the aforesaid problems connected with the use of clamps presently available.

The handles or other manipulating means open in a plane opposite to that of the occluding jaws. For instance, it can be readily appreciated from an inspection of FIG. 1 that movement of the handle members **12** in the horizontal plane results in corresponding movement of shafts **10** in a plane substantially perpendicular to the horizontal plane and movement of the occluding jaws in a substantially vertical plane.

These three distinct planes of action comprise a novel and essential feature of the invention and result in the aforesaid advantages of the clamps provided by this invention over those presently available.

In the use of the novel clamps of this invention, the occluding jaws are applied, for instance, to the side of the blood vessel and the handles, by virtue of the described configuration, can easily and safely be delivered out of the operative wound to lie flat on the surface without applying any torque or tension to the occluded tissue.

In such a position the handles are not subject to end-on forces, and in addition, occupy a plane distant from the immediate wound where application of such inadvertant forces would be less likely to occur. Further, lying at such a distance the handles do not serve as a ready trap to entangle sutures, etc., and can in addition, since they are lying flat, be covered with towels and thus isolated, a procedure not possible with present conventional clamps.

The operative exposure, and hence, working space and vision, are increased significantly due to the fact that the handles are directed entirely out of the wound and placed at a distance out of the way.

Because of the three dimensional action of the clamps of this invention, it is contemplated that mirror images of the clamps be provided to realize the advantages of this invention regardless to which side of an operative structure the clamps are applied. In this way, the surgeon may choose the most advantageous direction for the handles and shaft to exit from the wound. This unique feature does not apply to currently employed clamps in view of the fact that the handles and jaws of such instruments operate in the same or parallel planes of action, thus affording the surgeon little or no choice in the direction of protrudance of the handles, which is determined solely by the position of the structure to be clamped and the amount of torque or tension which may be safely applied to the clamped tissue.

Throughout the specification and claims, the term "angle" has been employed in describing the relationship of the various parts of the clamp to each other. It should be understood, however, that the various three-dimensional relationships of the clamps of this invention may be achieved by joining one or more members of the clamp together through an arc instead of a definite angle at the point of juncture. Thus, clamps, for instance, wherein manipulating members **12** may gradually curve to circumscribe an arc to join shaft members **10** will be understood to be contemplated by this invention.

I claim:

1. A surgical clamp comprising two lever arms, a pivot pin pivoting said lever arms relative to each other, each of said arms comprising a manipulating member, a shaft member, a pivot section and a jaw member, said pivot pin connecting said lever arms through said pivot sections, said shaft members being disposed at substantially right angles relative to said pivot sections and movable in a common plane with said pivot sections about said pivot pin, said manipulating members being angularly offset from said shaft members parallel to said pivot pin, and said jaw members being angularly offset from the plane of movement of said shaft members and said pivot sections for a clamping engagement with each other upon movement substantially orthogonal relative to the movement of said manipulating members.

2. A surgical clamp as set forth in claim 1 wherein the manipulating members are offset on the same side of the plane of movement of the shaft members as the jaw members.

3. A surgical clamp as set forth in claim 1, wherein the manipulating members and the jaw members are offset from the plane of movement of the shaft members in opposite directions.

4. A surgical clamp as set forth in claim 1 further comprising cooperable locking means on said manipulating members for releasably retaining said jaw members in a clamped position.

5. A surgical clamp comprising two lever arms, a pivot pin pivoting said lever arms relative to each other, each of said arms comprising a manipulating member, a shaft member, a pivot section and a jaw member, said pivot pin connecting said lever arms through said pivot sections, said shaft members being disposed at right angles relative to said pivot sections and movable in a common plane with said pivot sections about said pivot pin, said manipulating members being angularly offset from said shaft members parallel to said pivot pin, and said jaw members being angularly offset from the plane of movement of said shaft members and said pivot sections for clamping engagement with each other upon movement orthogonal relative to the movement of said manipulating members.

6. A surgical clamp as set forth in claim 5 wherein said manipulating members are angularly offset on the same side of the plane of movement of the shaft members as the jaw members.

7. A surgical clamp as set forth in claim 5 wherein the manipulating members and the jaw members are angularly offset from the plane of movement of the shaft members in opposite directions.

8. A surgical clamp as set forth in claim 5 further comprising cooperable locking means on said manipulating members for releasably retaining said jaw members in a clamped position.

9. A surgical clamp comprising two lever arms, a pivot pin pivoting said lever arms relative to each other, each of said arms comprising a manipulating member, a shaft member, a pivot section and a jaw member, said pivot pin connecting said lever arms through said pivot sections, said shaft members being angularly offset from said pivot sections in a common plane at an angle in the range of 30° to 150°, said manipulating members being angularly offset from said shaft members at an angle in the range of 25° to 155°, and said jaw members being angularly offset from the plane of movement of said shaft member and said pivot sections at an angle in the range of 15° to 165°, wherein the movement of said jaw members is orthogonal relative to the movement of said manipulating members when said manipulating members are parallel to said pivot pin.

10. A surgical clamp as set forth in claim 9, wherein the range of angles between said manipulating members and said shaft members is from 45° to 135°, the range of angles between said shaft members and said pivot sections is from 45° to 135° and the range of angles between said jaw members and said pivot sections is from 45° to 130°.

11. A surgical clamp as set forth in claim 9 wherein the manipulating members are angularly offset on the same side of the plane of movement of said shaft members as the jaw members.

12. A surgical clamp as set forth in claim 9 wherein the manipulating members and said jaw members are angularly offset from the plane of movement of the shaft members in opposite directions.

13. A surgical clamp as set forth in claim 9 further comprising cooperable locking means on said manipulating members for releasably retaining said jaw members in a clamped position.

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