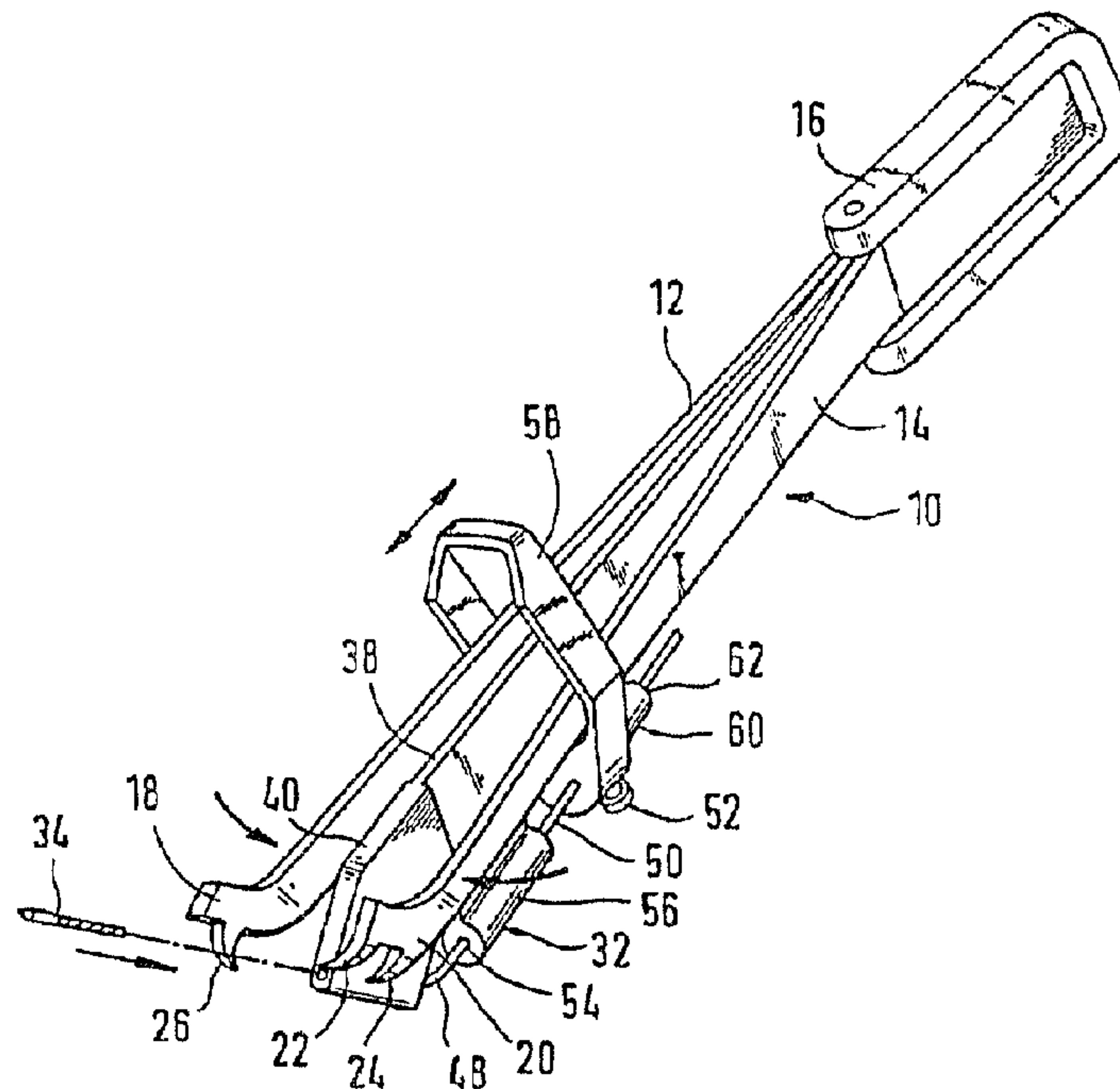




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(54) Title: APPARATUS AND METHOD FOR SUBCUTICULAR STAPLING OF BODY TISSUE



(57) **Abrégé/Abstract:**

A surgical apparatus is disclosed for attaching adjacent end portions of cutaneous body tissue wherein a pair of opposed jaws have means for moving the jaws toward and away from each other. Body tissue engaging means in the form of sharp tip members extend from each jaw and toward the other so as to engage the opposed portions of cutaneous tissue when the jaws are positioned thereagainst and moved toward each other. The jaws and the tips are arranged to cause the cutaneous tissue to assume an irregular shape at the interface whereby an elongated rod-like member, preferably rectangular in cross section, may be directed generally medially of the interface of the tissue to attach the opposed portions to thereby permit healing. The elongated member may have indentations to improve retention within the tissue. A tapered distal end of the elongated member has a pointed tip to facilitate penetration into the tissue.



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ABSTRACT

A surgical apparatus is disclosed for attaching adjacent end portions of cutaneous body tissue wherein a pair of opposed jaws have means for moving the jaws toward and away from each other. Body tissue engaging means in the form of sharp tip members extend from each jaw and toward the other so as to engage the opposed portions of cutaneous tissue when the jaws are positioned thereagainst and moved toward each other. The jaws and the tips are arranged to cause the cutaneous tissue to assume an irregular shape at the interface whereby an elongated rod-like member, preferably rectangular in cross section, may be directed generally medially of the interface of the tissue to attach the opposed portions to thereby permit healing. The elongated member may have indentations to improve retention within the tissue. A tapered distal end of the elongated member has a pointed tip to facilitate penetration into the tissue.

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APPARATUS AND METHOD FOR
SUBCUTICULAR STAPLING OF BODY TISSUE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus and method for subcuticular attachment of skin surrounding an opening wherein the opening is either caused unintentionally or by surgical procedure.

2. Description of the Prior Art

Modern day surgery using sutures and staples or the like is well defined. Generally, the key to successfully attaching cutaneous matter is the utmost gentleness in handling all tissue. Damaged and injured tissue leads to necrosis followed by fibrosis and scarring.

In handling tissue for attaching the surgical ends adjacent an opening, care must be taken in attaching the open ends to provide a minimum of the usual well-known telltale marks in the skin. For example, the application of sutures in cutaneous surgery will often result in the appearance of telltale crosshatch markings, whereas the use of sutures subcutaneously allows for early removal to minimize the telltale marks. Application of subcutaneous

sutures generally refers to introduction of sutures at well below the epidermis and dermis. Subcuticular sutures generally refer to sutures introduced beneath the epidermis. In any event, reference to attachment of cutaneous matter below the epidermis at any level is sometimes referred to as "subcutaneous".

Surgically attaching cutaneous matter is also accomplished by application of staples which are generally of a metal material and are closed by action against an anvil which causes the ends of the staple to close after piercing the skin surrounding an opening. In either case, the portions of skin are first drawn together and then stapled or sutured so as to hold them together until natural healing takes place. The steps are often cumbersome to the surgeon since holding the skin together requires one motion and stapling or suturing requires another.

To date, there does not appear to exist an apparatus which is capable of gripping the portions of cutaneous matter surrounding an opening and drawing them together, followed by introduction of a staple at subcuticular levels, i.e. below the epidermis. Neither does there appear to exist an apparatus which is capable of drawing the cutaneous matter together and firing a staple in the subcutaneous region, i.e. in the region below the dermis. The present invention is directed to such an apparatus and method for attachment of cutaneous matter.

SUMMARY OF THE INVENTION

A surgical apparatus for attaching at least two adjacent end portions of a medium such as cutaneous body tissue which comprises a pair of jaws,

means for moving the jaws toward and away from each other, and body tissue engaging means extending from each jaw and facing the opposed jaw and adapted to engage the respective opposed portions of the medium such that when the jaws are moved toward each other said engaging means causes the two end portions of the medium to be displaced toward each other and to assume an irregular or undulating shape whereby an elongated member may be directed generally medially of the medium to thereby attach opposed portions of the medium.

Means is provided to direct an elongated attaching member generally medially of the interface and subcuticularly of the body tissue to thereby attach the end portions. Preferably, each jaw includes a sharp pointed member positioned for engagement with marginal end portions of skin adjacent an opening therein such that when the jaws are displaced toward each other, the skin portions move toward each other and into engagement and assume an undulating configuration at the interface therebetween. The apparatus further comprises a cartridge positioned adjacent the jaws and adapted to support a plurality of elongated skin attaching members.

Each skin attaching member is preferably a rod-like member having a sharp pointed tip at the distal end to facilitate subcuticular penetration of the skin. In one embodiment, each rod-like member is circular in cross section and may include at least one slot extending at least partially around a peripheral portion thereof. In another embodiment, the rod-like members are substantially rectangular in cross section. Indentations may also be formed in the rods to improve retention in the tissue. This facilitates manufacture of the rods, improves feeding of the rods and increases their retention characteristics.

In another embodiment of the present invention, there is provided a surgical apparatus for attaching at least two portions of body tissue, which comprising: a pair of support members; a tissue gripping jaw supported at the distal end of each said support member; body tissue engaging means extending from each jaw and facing the opposed jaw and adapted to engage respective opposed portions of the body tissue such that when the jaws are moved towards each other the engaging means causes the opposed portions of body tissue to be displaced towards each other and engage at the interface thereof so as to assume an irregular shape whereby an elongated fastener member may be directed generally medially of the body tissue interface to thereby attach the opposed portions of the body tissue, and resilient means to bias the support members and the jaws in opposed directions. It is preferred in the above embodiment that the support members comprise a pair of handles, at least one handle being pivotally movable relative to the other handle.

In another embodiment of the present invention, there is provided a surgical apparatus for attaching at least two portions of body tissue, which comprises: a pair of opposed jaws; body tissue engaging means extending from each jaw and facing the opposed jaw and adapted to engage the respective opposed portions of the body tissue such that when the jaws are moved toward each other the engaging means causes the two end portions of the body tissue to be displaced towards each other and engage at the interface thereof so as to assume an irregular shape whereby a fastening member may be directed generally medially of the body tissue interface to thereby attach the opposed portions of the body tissue; and actuating means for moving the opposed jaws relative each other. It is desirable in this embodiment that the actuating means comprises at least one handle manually movable to actuate the mechanical means.

Another embodiment of the present invention provides for a surgical apparatus for attaching at least two portions of body tissue the improvement comprising: a pair of opposed jaws movable towards each other, means for moving said jaws toward and away from each other and body tissue engaging means extending from each jaw and facing the opposed jaw, said tissue engaging means, when placed in tissue

engaging relationship, being adapted to engage tissue portions therebetween and to form the tissue in an irregular shape to permit joinder of the tissue portions.

The apparatus in this embodiment can be used for attaching at least two adjacent end portions of a medium of a cutaneous body tissue, the body tissue engaging means is adapted to engage respective opposed portions of the medium such that when the jaws are moved toward each other the engaging means causes the two end portions of the medium to be displaced toward each other and engage at the interface thereof so as to assume an irregular shape whereby an elongated member may be directed generally medially of the medium interface to thereby attach the opposed portions of the medium.

It is a still further embodiment of the present invention to provide a surgical apparatus for attaching at least two adjacent end portions of a medium such as cutaneous body tissue, which comprises a pair of opposed jaws, body tissue engaging means extending from each jaw and facing the opposed jaw and adapted to engage the respective opposed portions of the medium such that when the jaws are moved toward each other the engaging means causes the two end portions of the medium to be displaced toward each other and engage at the interface thereof so as to assume an irregular shape whereby a fastening member may be directed generally medially of the medium interface to thereby attach the opposed portions of the medium, a plurality of rod-like fastener members positioned for sequential ejection generally medially of the jaws when the jaws are moved toward each other, and manually operable actuating means adapted to move the jaws toward each other for gripping the adjacent end portions of the medium.

Desirably, the resilient means comprises a spring and the jaws are each mounted on a handle and relative movement of the handles moves the jaws toward each other and means for causing ejection of at least one fastener into the interface of the medium.

In another embodiment of the present invention, there is provided a surgical

apparatus for attaching two portions of cutaneous body tissue, comprising a pair of opposed jaws, at least one of the opposed jaws being moveable by manually operable means from a first open position spaced apart from the other jaw to a second closed position adjacent the other jaw, each of the jaws having a member to engage one portion of the body tissue, the jaws having means for holding the portions of body tissue in approximation when moved to their closed position; and means adjacent the jaws for ejecting an elongated rod-like fastener into a path extending between the closed jaws. It is preferred in this embodiment, that the means adjacent the jaws for ejecting an elongated rod-like fastener through a path extending between the closed jaws, includes the feature that the jaws are adapted to hold the portions of body tissue in at least partially overlapping waveform and the surgical apparatus comprises means for defining the ejection path of the rod-like fastener, the means for holding the portions of body tissue in approximation comprises a pair of second gripping members on one of the jaws, and at least one gripping member positioned on the other of the jaws which intersects at least partially between the pair of spaced gripping members when the jaws are moved to their closed position, the fastener ejecting means comprises an elongated rod movable longitudinally to eject the rod-like fastener into the path, and the means for altering the path of the ejected rod-like fastener comprises an arcuate bore.

There is provided a further embodiment of the present invention wherein a surgical apparatus for attaching at least two adjacent opposed end portions of cutaneous body tissue, which comprises: a pair of opposed jaws movable toward and away from each other; body tissue engaging means extending from each jaw and facing the opposed jaw for engaging the respective opposed portions of the body tissue, such that when the jaws are moved toward each other the body tissue engaging means causes the two end portions of the body tissue to be displaced toward each other and engage at an engagement interface thereof so as to assume an irregular shape; fastener storing means positioned proximal of the pair of opposed jaws for storing at least one generally elongated fastener, such fastener defining a generally longitudinal axis; and means for advancing such at least one elongated fastener in generally the same direction as the longitudinal axis and generally medially of such

body tissue engagement interface to thereby attach the opposed end portions of the body tissue. A further embodiment of the above is where the storing means comprises a cartridge positioned adjacent the jaws and adapted to support a plurality of rod-like members.

In the present invention, another embodiment is provided, the apparatus being for attaching at least two adjacent end portions of cutaneous body tissue defining an opening and which comprises: a pair of opposed jaws movable toward and away from each other; body tissue engaging means attached to each jaw and facing the opposed jaw, the body tissue engaging means on each the jaw being configured, dimensioned, and relatively positioned such that when the jaws are respectively positioned against the end portions of the body tissue and the jaws are moved toward each other, the body tissue engaging means engage the end portions of the body tissue adjacent the opening and cause them to engage each other and to assume an undulating shape at the interface thereof; fastener storing means positioned proximal of the body tissue engaging means for storing at least one generally elongated attaching member; and d) means cooperative with the fastener storing means for directing such at least one elongated attaching member from a position generally medially and subcuticularly of the body tissue at such body tissue engagement interface to thereby attach the end portions.

Preferably, at least two elongated arms are connected to each other at one end portion and resiliently biased away from each other at the free end portion and the jaws are each respectively positioned at the free end portion of one of the arms and each jaw forms an obtuse angle with the respective elongated arm.

A further embodiment of the present invention is provided where an apparatus for attaching at least two adjacent end portions of cutaneous body tissue defining an opening, which comprises: first and second opposed jaws adapted to be selectively moved toward and away from each other; at least one generally pointed member extending away from the first jaw and generally toward the opposite jaw and at least two generally pointed members extending from the second jaw and generally toward

the first jaw, whereby when the first and second jaws are respectively positioned against the end portions of the body tissue and the jaws are moved toward each other, the generally pointed members of the jaws engage the end portions of the body tissue adjacent the opening and cause them to engage each other and to assume an undulating shape at the interface thereof; means positioned proximal of the jaws for storing at least one generally elongated body tissue attaching member; and, means cooperative with the storing means for directing such at least one elongated body tissue attaching member generally medially and subcuticularly of the body tissue at such body tissue engagement interface to thereby attach the end portions.

It is desirable in the preceding embodiment that two sharp pointed members are positioned in spaced relation on the second jaw and the first jaw includes the one sharp pointed member extending therefrom toward the second jaw at a location generally medially between the two sharp pointed members of the second jaw, the respective sharp pointed members are positioned for engagement with marginal end portions of the cutaneous body tissue adjacent an opening therein such that when the jaws are displaced toward each other, the body tissue portions move toward each other and into engagement and assume the undulating configuration at the interface therebetween, the storing means comprises a cartridge positioned adjacent the jaws and adapted to support a plurality of elongated body tissue attaching members, the cartridge includes means to resiliently bias the rod-like members toward a position for advancing the members distally toward the body tissue when the body tissue is gripped by the sharp pointed members, the body tissue attaching members are constructed of a bioabsorbable material, each body tissue attaching member is a rod-like member having a sharp pointed tip at the distal end to facilitate subcuticular penetration of the body tissue.

It is also desirable for the above embodiment that each rod-like member includes at least one slot extending at least partially around a peripheral portion thereof, each the rod-like member includes a plurality of partially annular slots extending over surface portions thereof, the slots are five partially annular cut-out portions on

opposed sides of each the rod-like member to provide a discontinuous surface to the rod-like member to retain the rod-like member in position within the body-tissue due to the interface between the body tissue and the discontinuous surface, the cartridge includes means to resiliently bias the rod-like members toward a position for advancing a member distally toward the body tissue when the body tissue is gripped by the sharp pointed members.

In another embodiment of the present invention, there is provided a surgical apparatus for subcutaneously attaching two adjacent end portions of skin defining an opening, which comprises: a pair of elongated members connected at one end portion and having two opposed jaws respectively positioned at the free end portion, the members being resiliently biased away from each other and adapted to be moved toward and away from each other; at least two generally sharp skin engaging members attached to a first of the jaws and extending in a direction generally toward the second of the jaws; at least one generally sharp skin engaging member attached to the second jaw and extending in a direction generally toward the first jaw, the skin engaging members being relatively positioned such that when the jaws are opened and the members are positioned against the end portions of the skin adjacent an opening therein, and the jaws are moved toward each other with the two adjacent end portions of skin gripped therebetween, the generally sharp skin engaging members engage the marginal end portions of skin adjacent the opening and cause them to assume an undulating shape; and means movable toward the first and second jaws for advancing a fastener member into the body tissue. For the above embodiment, it is preferable that the two generally sharp skin engaging members are attached to the first jaw in spaced relation to each other and the one generally sharp skin engaging member attached to the second jaw is positioned generally medially of the skin engaging members on the first jaw.

A further embodiment of the present invention provides for a surgical apparatus for engaging first and second body portions which comprises: a pair of opposed jaws; at least two spaced apart tissue engaging means positioned on a first of the jaws and adapted to engage the first body tissue portion; at least one tissue engaging

means positioned on a second of the jaws at a location generally between the first two tissue engaging means on the first jaw and adapted to engage the second body tissue portion, the jaws movable toward each other so as to approximate the first and second body tissue portions; and means movable toward the jaws for advancing fastener members generally between the jaws to attach the body tissue portions.

Another embodiment of the present invention is where there is provided a surgical apparatus for engaging first and second spaced body tissue portions and advancing elongated fastener members, which comprises: a pair of opposed jaws; at least two spaced apart tissue engaging means positioned on a first of the jaws and adapted to engage one of the body tissue portions; at least one tissue engaging means positioned on the second jaw, the last mentioned tissue engaging means positioned with respect to the first two tissue engaging means on the first jaw such that when the tissue engaging means are respectively positioned in engagement with the body tissue portions, and the jaws are advanced toward each other sufficient to cause the tissue portions to engage each other, the tissue portions assume an irregular shape at the interface thereof, the jaws movable toward each other so as to approximate the first and second body tissue portions; and means movable toward the jaws for individually advancing elongated fastener members generally medially of the jaws to attach the body tissue portions.

A still further embodiment of the present invention is where there is provided a surgical apparatus for engaging first and second spaced body tissue portions and advancing fastener members, which comprises: a pair of opposed jaws; at least two spaced apart tissue engaging members positioned on a first of the jaws and adapted to engage one of the body tissue portions; at least one tissue engaging member positioned on the second jaw, the last mentioned tissue engaging member positioned with respect to the first two tissue engaging members on the first jaw such that when the tissue engaging members are respectively positioned in engagement with the body tissue portions, and the jaws are advanced toward each other sufficient to cause the tissue portions to engage each other, the tissue portions assume an irregular shape at the interface thereof; means for supporting

the jaws to facilitate movement toward each other so as to approximate the first and second body tissue portions; and means movable toward the jaws for individually advancing fastener members from a position proximal of the jaws to a position between the jaws.

Another preferable embodiment of the present invention provides a surgical apparatus for engaging first and second body tissue portions and advancing a fastener member, which comprises: a pair of opposed jaws; at least two tissue engaging members positioned in spaced relation on a first of the jaws and extending in a direction generally toward the second jaw; at least one tissue engaging member positioned on a second of the jaws and extending generally in a direction toward the first jaw such that the tissue engaging members may be positioned in respective engagement with the body tissue portions and the jaws moved toward each other to move the correspondingly positioned body tissue portions toward each other therewith in engaged relation, the at least one tissue engaging member on the second jaw being positioned between the at least two tissue engaging members on the first jaw; and means positioned proximal of the jaws for advancing a fastener member into such engaged body tissue portions. It is desirable in this embodiment that such fastener member is elongated and the apparatus further comprises means to store a plurality of such elongated fastener members and the fastener member advancing means is adapted for individually advancing such fastener members.

A further preferred embodiment of the present invention provides for a surgical apparatus for attaching at least two adjacent end portions of cutaneous body tissue, which comprises: a pair of opposed jaws movable toward and away from each other; means positioned proximal of the jaws for storing a plurality of skin attaching fasteners, the fasteners comprising a generally straight rod-like elongated member having a sharp pointed tip at the distal end to facilitate subcuticular penetration into the marginal end portions of cutaneous body tissue to retain the end portions together, the member having at least one at least partially annular slot extending over a peripheral portion thereof to prevent exit from the cutaneous body tissue; and body tissue engaging means extending from each jaw and facing the opposed jaw

for engaging the respective opposed portions of the body tissue such that when the jaws are moved toward each other the engaging means causes the two end portions of the body tissue to be displaced toward each other and engage at the interface thereof so as to assume an irregular shape whereby the at least one elongated member may be directed generally medially of such body tissue engagement interface to thereby attach the opposed portions of the body tissue.

In another embodiment of the present invention, there is provided an apparatus for attaching at least two adjacent end portions of cutaneous body tissue defining an opening which comprises: at least two elongated arms connected to each other at one end portion and resiliently biased away from each other at the free end portion; a jaw positioned at the free end portion of each of the arms and movable toward and away from each other when the arms are moved toward and away from each other; body tissue engaging means attached to each jaw and facing the opposed jaw, and being configured and dimensioned such that when the jaws are respectively positioned against the end portions of the body tissue and the jaws are moved toward each other, the body tissue engaging means engage the end portions of the body tissue adjacent the opening and cause them to engage each other and to assume an undulating shape at the interface thereof; and means movable toward the jaws to introduce and direct an elongated attaching member generally medially and subcuticularly of the body tissue at the interface to thereby attach the end portions.

A still further preferred feature of the present invention includes a surgical fastening apparatus which comprises: a pair of jaws, each of the jaws having means for gripping a body tissue portion, the jaws movable toward each other to move the body tissue portions toward each other; fastener storing means positioned adjacent the pair of jaws and storing at least one elongated fastener; and means cooperative with the fastener storing means for introducing and directing the at least one elongated fastener into the body tissue portions at a location such that contact between the fastener and the jaws is avoided. Preferably, in the above embodiment, the pair of jaws are normally biased away from each other, the gripping

means comprises at least one sharp pointed member extending from each of the jaws, the fastener directing means comprises a member having a distal surface adapted to contact a proximal surface of the at least one fastener, the fastener storing means is configured to store a plurality of fasteners in stacked relation, the at least one fastener is composed of a bioabsorbable material.

The present invention also provides an embodiment of a surgical fastening apparatus which comprises: a pair of jaws, each of the jaws having means for gripping a body tissue portion, the jaws being supported by support means and movable toward each other to move the body tissue portions toward each other into engagement; means positioned adjacent the jaws for storing a plurality of elongated rod-like fasteners in generally vertically stacked relation; and means cooperative with the fastener storing means for contacting and directing a bottommost fastener of the plurality of stacked fasteners into such engaged body tissue portions.

Another embodiment of the present invention provides a surgical fastening apparatus which comprises: a first tissue gripping member; a second tissue gripping member; means for moving at least one of the tissue gripping members towards the other tissue gripping member; fastener storing means positioned proximal of the tissue gripping members and storing at least one elongated fastener, the elongated fastener defining a generally longitudinal axis; and means for advancing the at least one elongated fastener into the tissue in generally the same direction as the longitudinal axis after at least one of the tissue gripping members is moved towards the other member. Desirably, the first and second gripping members each comprise at least one sharp pointed member, the at least one sharp pointed member on the first and second gripping members extends inwardly, the elongated fastener has a pointed tip, the fastener storing means comprises a cartridge for supporting a plurality of elongated fasteners in stacked relation, the fastener directing means is adapted to come into contact with a proximal end of the fastener to direct it subcuticularly into the tissue, means for biasing the first and second gripping members away from each other, the at least one fastener is composed of a bioabsorbable material.

Another form of the present invention includes an apparatus for attaching at least two adjacent end portions of cutaneous body tissue defining an opening which comprises: first and second elongated arms connected to each other at one end portion and adapted to be selectively moved toward and away from each other, the elongated arms resiliently biased away from each other at the free end portions thereof; first and second opposed jaws respectively positioned at the free end portions of the first and second elongated arms, and forming an obtuse angle with the respective elongated arm, the first jaw including at least one sharp pointed member extending away from the jaw and generally toward the opposite jaw, the second jaw including at least two sharp pointed members extending therefrom and generally toward the first jaw, whereby when the first and second jaws are respectively positioned against the end portions of the body tissue and the jaws are moved toward each other, the pointed members of the jaws engage the end portions of the body tissue adjacent the opening and cause them to engage each other and to assume an undulating shape at the interface thereof; means spaced from the jaws for storing at least one generally elongated attaching member; and means adapted to cooperate with the storing means for directing the at least one elongated attaching member generally medially and subcuticularly of the body tissue at such body tissue engagement interface to thereby attach the end portions.

It is a further embodiment of the present invention to provide a surgical apparatus for attaching at least two adjacent end portions of cutaneous body tissue, which comprises: a pair of opposed jaws; means for supporting the jaws for movement toward and away from each other; means spaced from the pair of opposed jaws for storing at least one generally elongated fastener member; body tissue engaging means extending from each jaw and facing the opposed jaw for engaging the respective opposed portions of the body tissue, one of the jaws having a greater number of body tissue engaging means than the other jaw, the body tissue engaging means being respectively configured, dimensioned and relatively positioned such that when the jaws are moved toward each other the body tissue engaging means causes the two end portions of the body tissue to be displaced toward each other and engage at the interface thereof so as to assume an

irregular shape; and means movable for engagement with such elongated fastener member for directing such at least one elongated member generally medially of such body tissue engagement interface to thereby attach the opposed portions of the body tissue.

Another embodiment of the present invention provides a surgical apparatus for attaching at least two end portions of cutaneous body tissue adjacent an opening in the body tissue, which comprises: first tissue gripping member; second tissue gripping member positioned opposite and movable toward the first tissue gripping member; at least one elongated tissue fastening member supported proximal of the tissue gripping members; and a pusher engagable with the at least one elongated tissue fastening member for advancing the at least one elongated tissue fastening member into the body tissue without substantial deformation by the tissue fastening member.

The present invention provides a still further embodiment for a surgical apparatus for attaching at least two end portions of cutaneous body tissue adjacent an opening in the body tissue, which comprises: first tissue gripping member; second tissue gripping member movable toward the first tissue gripping member such that engagement of the first and second tissue gripping members with the respective end portions of cutaneous body tissue and movement of the first and second tissue gripping members toward each other causes the end portions to move toward each other to form an irregular surface at the interface thereof; at least one elongated fastener member supported proximally of the gripping members; and a pusher proximal of the tissue gripping members and engagable with the at least one elongated fastener member for advancement of an elongated fastening member longitudinally with respect to the opening in the body tissue.

Another form of the present invention, is a surgical apparatus for attaching two portions of body tissue, which comprises: a pair of opposed jaws each having a member to engage one portion of the body tissue, means supporting the jaws for moving at least one of the jaws toward the other jaw to move the body tissue

portions toward one another; a chamber supported proximally of the jaws for holding a plurality of rod-like members; and a plurality of rod-like members disposed in the chamber, each rod-like member being elongated and of sufficient length to penetrate the body tissue portions when drawn together, each rod-like member further being substantially rectangular in cross-section.

It is a preferred feature of the above embodiment that the rod-like member comprises a distal end having a tapered tip having a sharp point for penetrating the body tissue and a proximal end, the chamber is dimensioned to receive and support the rod-like members in a stacked relationship, further comprises means for driving the rod-like members outwardly from the chamber into the body tissue, an indentation formed adjacent the proximal end of each the rod-like member to restrict linear movement after insertion into the body tissue, the rod-like members are composed of a bioabsorbable material.

The present invention also provides a surgical apparatus for attaching at least two portions of body tissue, which comprises: a pair of jaws respectively supported in opposed relation, each jaw having a member to engage one portion of the body tissue, at least one of the jaws movable toward the other jaw to move the body tissue portions toward one another; a chamber for supporting a plurality of rod-like members, the chamber disposed and supported proximally of the jaws, each the rod-like member being of sufficient length to penetrate the two body tissue portions when drawn together, each the rod-like member having a cross-sectional configuration to facilitate stacking of the rod-like members in contacting relationship; and a pusher movable within the chamber for advancing the rod-like members into the at least two body tissue portions without substantial deformation thereof. It is desirable that each jaw is supported so as to be movable toward and away from the opposed jaw to move the body tissue portions toward one another to a position wherein the body tissue portions are drawn together in close approximation, and wherein each the rod-like member is individually movable to penetrate the body tissue portions when drawn together in close approximation, each the rod-like member has at least one substantially planar surface which extends longitudinally

along the rod-like member, whereby the rod-like members are laterally stacked along the longitudinally extending planar surfaces to form a stacked arrangement, the rod-like members are stacked laterally in surface-to-surface contact, the cross-sectional configuration of each the rod-like members is square, the cross-sectional configuration of each the rod-like members is hexagonal, the rod-like member is of substantially circular cross-section.

It is also an embodiment of the present invention to provide a surgical apparatus for attaching two portions of body tissue, which comprises: a pair of opposed jaws, each jaw having a member adapted to engage one portion of the body tissue, at least one of the jaws movable towards the other jaw to move the body tissue portions toward one another; and a plurality of rod-like members disposed and supported proximally of the jaws, each the rod-like member being of sufficient length to penetrate the two body tissue portions when drawn together, each the rod-like member having a rectangular cross-sectional configuration to facilitate stacking of the rod-like members; and a pusher engageable with the rod-like members for advancing the rod-like members into the body tissue portions.

Preferably, each rod-like member includes at least three planar outer surfaces extending longitudinally therealong, and each rod-like member is of sufficient rigidity to substantially retain the substantially straight elongated shape upon insertion into body tissue.

In a further embodiment of the present invention, there is provided a surgical apparatus for attaching two portions of cutaneous body tissue, which comprises: a pair of opposed jaws, each jaw having a member to engage one portion of the body tissue, at least one of the jaws movable toward the other jaw to move the body tissue portions toward one another; and a plurality of rod-like members disposed and supported proximally of the jaws, each the rod-like member being of sufficient length to penetrate the two body tissue portions when drawn together, each the rod-like member having a side portion adapted to cooperate with a side portion of an adjacent rod-like member to facilitate lateral stacking of the rod-like members; and a

pusher engageable with the rod-like members for advancing the rod-like members into the body tissue portions.

A still further preferred form of this embodiment comprises an indentation formed in the distal end of the rod-like member to restrict linear movement of the rod-like member after insertion into the body tissue and the rod-like members have a substantially straight elongated shape and are of sufficient rigidity to substantially retain the substantially straight elongated shape upon insertion into body tissue, the rod-like members each defining a longitudinal axis extending therethrough, and applied to the body tissue in general alignment with the longitudinal axis.

In the preferred embodiment the cartridge is adapted to contain a plurality of the rod-like members and includes means to resiliently bias the rod-like members toward a position for advancing the member distally toward the body tissue when the body tissue is gripped by the sharp pointed members. The members are of length sufficient to engage oppositely sloped skin portions as determined by the dimensions and relative spacing of the pointed tips. Further, the rod-like members may include means on the outer surface to retain them in position within the body tissue.

A method is also disclosed for attaching two adjacent end portions of skin surrounding an opening comprising gripping one marginal end portion of the skin adjacent the opening at two spaced locations, gripping the opposite marginal end portion of the skin at a location generally medial of the two locations at which the first marginal end portion is gripped, displacing the two end portions of skin surrounding the opening toward each other sufficient to cause the end portions to engage each other and to assume an undulating shape, and introducing an elongated staple into the end portions of the skin subcuticularly, the elongated staple being of length sufficient to penetrate at least two spaced portions of skin on the same side of the opening so as to retain the marginal end portions together in end to end contacting relation to promote healing. As noted, the method may comprise configuring the staple to have an irregular outer surface to prevent the staple from working itself out of the subcuticular region. Various configurations of the staple are also contemplated.

Preferably, the method is practiced utilizing sharp skin engaging members attached to jaws as described to permit gripping the skin and bringing the end portions adjacent an opening to form the undulating shape.

According to the method contemplated, the staple may also be inserted subcutaneously.

BRIEF DESCRIPTION OF THE ACCOMPANYING FIGURES

Preferred embodiments of the invention are described hereinbelow with reference to the drawings herein:

FIG. 1 is a perspective view of the apparatus for stapling body tissue according to the invention;

FIG. 2 is a view from above, greatly enlarged, illustrating the pointed gripping members of the apparatus of Fig. 1 prior to gripping the body tissue for subcuticular attachment;

FIG. 3 is a view from above, greatly enlarged and partially in cross-section, of the pointed gripping members of the apparatus of Fig. 1, just prior to subcuticular introduction of a staple;

FIG. 4 is a view from above, similar to Fig. 3 after subcuticular introduction of the staple;

FIG. 5 is a view partially in cross-section, taken along lines 5-5 of Fig. 4 and illustrating one embodiment of the subcuticularly positioned staple after firing the apparatus;

FIG. 6 is a view partially in cross-section, taken along lines 6-6 of Fig. 5;

FIG. 7 is a cross-sectional view, greatly enlarged, taken along lines 7-7 of Fig. 5, illustrating one embodiment of the staple subcuticularly embedded in the skin portions attached thereby;

FIG. 8 is a greatly enlarged side view, partially in cross-section, illustrating the staple cartridge which forms part of the invention;

FIG. 9 is a greatly enlarged view of an alternate embodiment of the staple of the present invention;

FIG. 10 is a greatly enlarged view of another alternate embodiment of another staple of the present invention;

FIG. 11 is a cross-sectional view of the staple of Figures 9 and 10; and

FIG. 12 is a cross-sectional view of several staples shown in stacked relationship.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 illustrates the apparatus 10 for subcuticular stapling of skin, constructed according to the present invention. The apparatus 10 includes elongated arms 12 and 14 connected as shown by end bracket 16 and resiliently biased away from each other. The resilient outward bias may be provided naturally by fabricating the arms 12 and 14 of a resilient material such as spring steel, or optionally may be provided by incorporating a separate resilient spring in region of connecting bracket 16.

The lower end portion of each arm is constructed as shown. Arm 12 includes an extension or jaw 18 oriented at an appropriate obtuse angle with respect to the main portion of the arm and arm 14 includes a similar extension or jaw 20 as shown. The extension 20 includes sharp pointed skin gripping tips 22, 24 spaced apart from each other and extending generally downwardly and toward extension 18. Extension 18 includes a similarly shaped skin

gripping tip 26 oriented generally downwardly and extending toward extension 20. The position of skin gripping tip 26 on extension 18 is preferably such as to be located medially between skin gripping tips 22, 24 when the arms 12 and 14 are manually brought together to grip the skin surrounding an opening as will be described. Each skin gripping tip 26, 22, 24 includes a broad base area to facilitate grasping the skin with minimum cutting after the sharp tip has penetrated the surface. Alternatively, a different number of skin gripping tips could be provided on each arm.

Referring now to Fig. 2, the basic operative principles of the invention will be described. There is illustrated the upper surface of skin 28 surrounding an opening such as a wound or surgically provided opening. The apparatus is positioned such that extensions 18, 20 may be positioned in contact with, and generally parallel to the upper surface of the skin. To close the opening in the skin the extensions are advanced downwardly against the skin sufficient to cause piercing tips 22, 24 and 26 to pierce the skin minimally as shown. Thereafter, the arms 12, 14 are squeezed together by the surgeon to cause the three sharp tips to join the skin portions surrounding the opening as shown in Fig. 3, i.e. to assume an undulating, or sinusoidal shape. Then, the staple actuating mechanism 32 is fired to cause the elongated staple 34 to penetrate the tissue below the upper epidermal layer and to retain the separate portions of skin in interfacial engaged relation as shown in Fig. 4. Thus, the opening in the skin is prepared for natural permanent healing and adhesion with minimum or no scarring.

Referring to Fig. 5 there is illustrated a cross-sectional view taken along lines 5-5 of Fig. 4, showing the sharp tips 26, 22 and 24 in position

securing the skin surrounding the opening 30 with staple 34 fired in position. At this point in the closing sequence, the inward pressure on arms 12, 14 of the apparatus may be relieved to permit them to be opened by the resilient spring action and the sharp tips may be removed from the skin. Depending upon the nature and size of the opening in the skin, one or more of the staples may be fired in sequence and in adjacent end to end relation sufficient to maintain the opening in closed condition to promote healing. Thus, the nature of the staple and the capability of repeated firing will now be described.

The staple according to the invention is preferably constructed as a sharp tipped elongated member of naturally bioabsorbable material such as synthetic polymers or copolymers possessing a significant number of short-chain polyester linkages or other readily hydrolyzable linkages in their structure as, for example, is the case with polyglycolic acid, lactide-glycolide polymers, polydioxanone, polyalkylene glycols, polytrimethylene carbonate, polycaprolactone, their copolymers and related materials. One preferred material is made of a copolymer of lactide and glycolide made from approximately 90% m glycolide and approximately 10% m lactide. Another bioabsorbable material is made of a copolymer of lactide and glycolide made from approximately 25% m glycolide and approximately 75% m lactide blended with a homopolymer of polyglycolide so that the total composition is composed of approximately 42% glycolide. Other bioabsorbable materials for constructing the staple are disclosed in U.S. Patent No. 4,523,591 to Kaplan et al. and U.S. Patent No. 4,744,365 to Kaplan et al., herein incorporated by reference.

In the embodiment of a staple or fastening member shown in Figures 5 and 6, the fastening member is in the form of a rod or pin having a generally circular cross-section and must be of length at least sufficient to extend over at least two oppositely sloped surfaces of the skin on one side of the opening in order to prevent the staple from readily working its way out of the skin. To promote an even greater capability to maintain the portion of the staple in the skin, the staple preferably includes up to five or more slots 36 spaced along the length thereof to provide an irregular surface in engagement with the skin. This provides further stability to the staple and assists in preventing the staple from working its way out of the skin while retaining its rod-like configuration after application. The slots 36 may extend partially around the staple as shown in cross-section in Fig. 7, or they may be annular as to extend completely around the staple. It will be seen that in the preferred embodiment shown in the cross-section of Fig. 7, the slots 36 extend approximately between the 2 o'clock and 5 o'clock positions and the 7 o'clock and 10 o'clock positions. This feature is particularly significant in view of the undulating shape which the skin assumes at the interface between the two faces of the opening 30, which provides an environment for the rod to otherwise work itself out of the skin when the skin portions are shifted due to motions of the body.

The annular slots in the staple provide sufficient ridges and surface directional changes which engage the skin to prevent self working of the rod out of the skin. This feature is more clearly illustrated in Fig. 6 which shows the skin portions 28 surrounding the opening in cross-section and the staple 34 embedded therewithin. In one embodiment, the staple may be

approximately .350 inch in length, have a major outer diameter between .015 and .016 inch and a minor dimension at the slots of between .012 and .013 inch. Preferably, the staple is of length at least equal to the dimension between the sharp skin engaging tips 22, 24 on extension 20. Clearly, however, the dimensions may be varied, depending upon the particular application contemplated.

The circular shaped rod of Figures 5 and 6 is one example of the staple (fastening member) of the present invention which can be utilized to fasten the undulating skin. In an alternate embodiment shown in Figure 9, the staple 70 is in the form of a rod or pin which is generally rectangular in cross section. In the illustrated embodiment, it is substantially square in cross section. Rod 70 is elongated and of sufficient length to extend over at least two oppositely sloped surfaces of the skin on one side of the opening. The tapered tip 72 at the distal end of rod 70 has a sharp point 74 to facilitate penetration through the skin. In an alternate embodiment shown in Figure 10, rod 80 is also of substantially square cross section, and has a tapered tip 82 with a sharp point 84. The rod 80 includes an indentation 86 adjacent its distal end and an indentation 88 adjacent its proximal end to improve the retention of the rod by restricting proximal and distal movement. That is, since the tissue stretches during penetration of the rod and then retracts, the edge of the indentation will restrict movement. Although only one indentation is shown at each end, clearly additional indentations can be formed along the length to improve retention. The indentations can be formed on opposing surfaces or the indentations can extend along all side surfaces. Proximal end surface 87 of rod 80 and proximal end surface 77 of rod 70 are

adapted to be contacted directly by a pusher for driving the rod which will be described below. The rod is sufficiently rigid to substantially retain its elongated shape upon insertion. The rectangular shaped configuration of the rods facilitates stacking of the rods within staple cartridge 40 as described below. This configuration also provides for improved retention within the skin as the rods do not work their way out of the skin as easily as the rounded shaped rods.

The rods of Figures 9 and 10 also have the advantage in accommodating inaccuracies in molding techniques. Line P represents the parting line of the two half molds utilized in forming rods 70 or 80. The accuracy of molding the rods of Figures 9 and 10 can be improved by forming the rod with cut edges 90 so that the parting line P for the half molds is located at a non-critical point i.e. along edges 90. That is, the more critical dimensions (e.g. length) of edges 92, 94, 96 and 98 can be maintained substantially constant even if the edges 90 are not aligned as a result of joining the two half molds during formation of the rod. In other words, any variation in the widthwise dimension as a result of misalignment during formation will not significantly vary the length of the more critical edges.

Cut or flattened edges 90 also provide a smoother surface for the rods 70, 80, thereby preventing cutting of the tissue which might otherwise occur if the junction of edges 92, 94, 96, 98 was a single point as in a perfect square.

Clearly, other shapes of rods are within the scope of the present invention as long as they are sufficiently elongated to penetrate at least one of the undulating portions of the opposing skin areas. For example, rods of hexagonal cross section could be provided.

The dimensions of the rod can vary depending on its use. By way of example only, in one embodiment the length of the rod 70 can range from .440 to .445 inches, the length of each side edge (e.g. edges 92, 94, 46 and 98) can range from approximately .0245 to .0265 inches and the length of edge 90 can range from approximately .0036 to .0056 inches. In this embodiment, the tapered tip forms a point at an approximate 30° angle and the tip portion can have a length ranging from approximately .0653 to .0693 inches. If an indentation is provided, the indentation can have a depth of approximately .003 to .004 inches. Clearly, these dimensions are provided solely by way of example as rods of other dimensions are also within the scope of the present invention.

Referring to Fig. 8 in conjunction with Fig. 1, one embodiment of a staple cartridge is illustrated which can provide repeated firing of staples subcuticularly into the skin as shown in Fig. 1. The apparatus includes a central arm 38 with staple cartridge 40 attached to the lower end. The cartridge contains a plurality of staples 34 in vertically stacked relation as shown in Fig. 8, biased downwardly toward the firing chamber 42 by a plunger 44 and resilient spring arrangement 46 shown schematically in Fig. 8. Thus after each staple is fired, the staple next in line automatically positions itself in the chamber 42 under downward action of plunger 44. The cross-sectional dimension of chamber 42 is equal to or slightly greater than the major diameter of the staple 34 to facilitate a snug fit for the staple in the chamber. The length of cartridge 40 and chamber 42 is at least equal to the length of the staples.

The configuration of rods 70 and 80 facilitates stacking as they can be stacked along their straight edges. Rods 70 can be vertically stacked in a similar fashion as rods 30. Alternately, as shown in Figure 12, rods 70 can be diagonally stacked along edge 94. This advantageously conserves space as compared to the vertical stacking of rods 30. Rods 80 can be stacked in a similar fashion as rods 70. Clearly, the cartridge would be appropriately configured to accommodate the diagonally stacked rods.

The firing mechanism includes a staple firing plunger in the form of a flexible plunger wire 48 which is slidable through staple firing chamber 42 to engage the staple next in line to cause it to advance into the skin at a subcuticular level. The cross-section of firing wire 48 approximately matches the cross-section of staple 34 or of staple 70 and is attached at the proximal end to rod 50 as shown in Fig. 1, which is slidable within opening 54 in guide housing 56 such that proximal upward movement of rod 50 causes withdrawal of wire 48, and distal downward movement thereof causes firing action by wire 48 on staple 34. Staple firing may be accomplished by manual downward distal movement of ring 58 attached to rod 50 as shown by set screw 52. Withdrawal of firing wire 48 out of firing chamber 42 is accomplished by manually moving ring 58 (and rod 52) proximally upwardly to permit the next staple 34 to enter the firing chamber 42 under downward action of spring 46. Further guidance for rod 50 is provided by proximally located second external guide housing 60 which contains a second guide opening 62 for reception of rod 50. Thus the two guide housings 56 and 60 serve to firmly position rod 50.

The firing movements of wire 48 may be adjusted by resetting the position of rod 50 relative to ring 58 by loosening set screw 52 and setting

the desired position of rod 50. Further, it is noted that guide openings 54 and 62 are circular in cross-section almost equal to or slightly greater in dimension than rod 50. Sufficient clearance is provided to guide rod 50 yet to maintain steady slidable movement of the rod. Plunger wire 48 has a cross-sectional dimension slightly less than staple firing chamber 42 but sufficient to maintain steady distal and proximal movement therewithin while engaging the proximal end face of the staple. The staple 34 and the firing wire 48 are similarly dimensioned in cross-section, at least at the proximal end, such that engagement of the proximal surface of the staple by the wire 48 results in even and steady distal movement of the staple when the wire is advanced distally.

In operation, the apparatus is inserted into the opening in the skin closest to one end with the jaws 18, 20 positioned in respective engagement with the opposed marginal skin portions adjacent the opening. The jaws are advanced toward the skin sufficient to cause the sharp tips 26, 22 and 24 to grip the skin by piercing the outer layer or layers. Thereafter, the arms 12, 14 are manually drawn together to cause the skin to engage each other and to form an irregular, or undulating shape. At this time, the staple 34 is fired into the cutaneous matter as shown in Fig. 4 to retain the opposed skin portions together. The jaws are then withdrawn from the skin and the procedure is repeated in the area next adjacent the inserted fastener a sufficient number of times to close the entire opening in the skin.

Although a preferred embodiment of the multiple fire staple cartridge has been described, the structures and embodiments of alternative staple magazines may be utilized in combination with the multiple tip attachment

feature which permit subcuticular stapling of an opening in body tissue.

Further, although the preferred embodiment herein contemplates subcuticular attachment of cutaneous matter, it is well within the contemplated invention to apply such staples at subcutaneous levels, ie. below the epidermis and dermis. Such applications would involve minor variations of the dimensional relation between the sharp tips 22, 24 and 26 and the staple firing chamber 42.

It can be readily appreciated that a surgical opening or wound in the skin can be stapled utilizing the apparatus of the invention, leaving little or no extraneous staple markings or puncture wounds. Further, the resulting opening in the skin can be attached with greater precision and accuracy with the result that improved healing may be promoted with less visible wound indicia.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A surgical apparatus for attaching at least two adjacent end portions of a medium such as cutaneous body tissue, which comprises:
 - a) a pair of opposed jaws;
 - b) means for moving said jaws toward and away from each other; and
 - c) body tissue engaging means extending from each jaw and facing the opposed jaw and adapted to engage the respective opposed portions of the medium such that when the jaws are moved toward each other said engaging means causes the two end portions of the medium to be displaced toward each other and engage at the interface thereof so as to assume an irregular shape whereby an elongated member may be directed generally medially of said medium interface to thereby attach the opposed portions of the medium.
2. A surgical apparatus as recited in claim 1, further comprising means to direct an elongated attaching member generally medially and subcuticularly of the body tissue at the interface to thereby attach the end portions.
3. The apparatus according to claim 2 wherein at least two elongated arms are connected to each other at one end portion and resiliently biased away from each other at the free end portion and said jaws are each respectively positioned at the free end portion of one of said arms.
4. The apparatus according to claim 3 wherein said body tissue engaging means on said first jaw includes at least one sharp pointed member extending away from said jaw and generally toward said opposite jaw, and said body tissue engaging means on said second jaw includes at least two sharp pointed members extending therefrom and generally toward said first jaw.
5. The apparatus according to claim 4 wherein said two sharp pointed members are positioned in spaced relation on said second jaw and said

sharp pointed member of said first jaw extends toward said second jaw at a location generally medially between said two sharp pointed members of said second jaw.

6. The apparatus according to claim 2 further comprising a cartridge positioned adjacent said jaws and adapted to support a plurality of elongated attaching members, said cartridge including means to resiliently bias said elongated members toward a position for advancing the elongated member distally toward the body tissue when the body tissue is gripped by said sharp pointed members.

7. The apparatus according to claim 6 wherein said elongated attaching members are constructed of a bioabsorbable material.

8. The apparatus according to claim 6 wherein each elongated attaching member is a rod-like member having a sharp pointed tip at the distal end to facilitate penetration of the body tissue.

9. The apparatus according to claim 8 wherein each said elongated member includes at least one partially annular slot extending over surface portions thereof to retain said elongated member in position within the body tissue.

10. The apparatus according to claim 2 wherein said directing means comprises means for individually advancing each elongated member subcuticularly into the body tissue for attachment of the two end portions thereof while the end portions are retained in engaged relation by said sharp pointed members.

11. The apparatus according to claim 10 wherein said means for advancing said elongated attaching member subcuticularly into the body tissue is an elongated flexible member of approximately the same cross-sectional dimension

and shape as said elongated attaching member and positioned to engage one end portion of said elongated attaching member to cause distal movement thereof into the body tissue.

12. The apparatus according to claim 11 further comprising an elongated rigid rod attached to said flexible member for guided movement toward and away from said cartridge and said elongated members.

13. A surgical apparatus for attaching two portions of cutaneous body tissue comprising:

a pair of opposed jaws each having a member to engage one portion of the body tissue,

means for moving at least one of said jaws towards the other jaw to move said body tissue portions toward one another;

a chamber disposed proximally of said jaws for holding a plurality of rod-like members; and

a plurality of rod like members disposed in said chamber, each rod being elongated and of sufficient length to penetrate said two body tissue portions when drawn together.

14. A surgical apparatus as recited in claim 13, wherein each said rod like member has a tapered tip having a sharp point for penetrating the tissue and has at least three substantially planar outer surfaces extending longitudinally therealong.

15. A surgical apparatus as recited in claim 14, wherein said rod-like member is substantially rectangular, square, or hexagonal in cross section.

16. A surgical apparatus as recited in claim 13, wherein said chamber is dimensioned to receive said rods in diagonally stacked relationship.

17. A surgical apparatus as recited in claim 13, further comprising an indentation formed in said rod-like member to restrict linear movement of said member after insertion into the body tissue.

18. A surgical apparatus as recited in claim 13, wherein said rod-like member is composed of a bioabsorbable material.

19. A surgical fastening member for attaching at least two portions of cutaneous body tissue comprising a substantially straight elongated body member of sufficient rigidity to substantially retain its elongated shape upon insertion into the body tissue, said elongated body member terminating in a tapered tip portion at one end and being configured at the opposite end to permit full insertion into cutaneous body tissue portions, and said elongated member being dimensioned to penetrate said at least two portions of cutaneous body tissue when drawn towards each other.

20. A surgical fastening member as recited in claim 19, wherein said fastening member is substantially rectangular in cross section.

21. A surgical fastening member as recited in claim 19, wherein said elongated member has at least one planar surface extending longitudinally along said member which facilitates stacking said rod-like member laterally in face-to-face contacting relationship on said respective planar surface.

22. Use of the surgical apparatus according to any one of claims 1 to 18 for attaching two adjacent end portions of skin surrounding an opening.

23. Use of the surgical fastening member according to any one of claims 19 to 21 for attaching two portions of cutaneous body tissue.

24. A surgical apparatus for attaching at least two portions of body tissue, which comprises:

- a) a pair of support members;
- b) a tissue gripping jaw supported at the distal end of each said support member;
- c) body tissue engaging means extending from each jaw and facing said opposed jaw and adapted to engage respective opposed portions of the body tissue such that when said jaws are moved towards each other said engaging means causes said opposed portions of body tissue to be displaced towards each other and engage at the interface thereof so as to assume an irregular shape whereby an elongated fastener member may be directed generally medially of said body tissue interface to thereby attach the opposed portions of the body tissue; and
- d) resilient means to bias said support members and said jaws in opposed directions.

25. The surgical apparatus of claim 24, wherein said support members comprise a pair of handles, at least one handle being pivotally movable relative to the other handle.

26. A surgical apparatus for attaching at least two portions of body tissue, which comprises:

- a) a pair of opposed jaws;
- b) body tissue engaging means extending from each jaw and facing said opposed jaw and adapted to engage the respective opposed portions of the body tissue such that when said jaws are moved toward each other said engaging means causes said two end portions of the body tissue to be displaced towards each other and engage at the interface thereof so as to assume an irregular shape whereby a fastening member may be directed generally medially of said body tissue interface to thereby attach the opposed portions of the body tissue; and
- c) actuating means for moving said opposed jaws relative each other.

27. A surgical apparatus as recited in claim 26, wherein said actuating means comprises at least one handle manually movable to actuate said mechanical means.

28. In a surgical apparatus for attaching at least two portions of body tissue the improvement comprising: a pair of opposed jaws movable towards each other means for moving said jaws toward and away from each other and body tissue engaging means extending from each jaw and facing the opposed jaw, said tissue engaging means, when placed in tissue engaging relationship, being adapted to engage tissue portions there between and to form the tissue in an irregular shape to permit joinder of the tissue portions.

29. The surgical apparatus of the above claim 28, wherein said apparatus is for attaching at least two adjacent end portions of a medium of a cutaneous body tissue.

30. The surgical apparatus of the above claim 28, wherein said body tissue engaging means is adapted to engage respective opposed portions of the medium such that when the jaws are moved toward each other said engaging means causes the two end portions of the medium to be displaced toward each other and engage at the interface thereof so as to assume said irregular shape whereby an elongated member may be directed generally medially of said medium interface to thereby attach the opposed portions of the medium.

31. A surgical apparatus for attaching at least two adjacent end portions of a medium such as cutaneous body tissue, which comprises:

a) a pair of opposed jaws;

b) body tissue engaging means extending from each jaw and facing said opposed jaw and adapted to engage the respective opposed portions of the medium such that when said jaws are moved toward each other said engaging means causes said two end portions of the medium to be displaced toward each other and engage at the interface thereof so as to assume an irregular shape whereby a fastening member may be directed generally medially of said medium interface to thereby attach the opposed portions of the medium;

c) a plurality of rod-like fastener members positioned for sequential ejection

generally medially of said jaws when said jaws are moved toward each other; and

d) manually operable actuating means adapted to move said jaws toward each other

for gripping the adjacent end portions of the medium.

32. The surgical apparatus of claim 24, wherein the resilient means comprises a spring.

33. The surgical apparatus of claim 31, wherein said jaws are each mounted on a handle and relative movement of the handles moves said jaws toward each other and means for causing ejection of at least one fastener into the interface of said medium.

34. A surgical apparatus for attaching two portions of cutaneous body tissue, comprising:

a pair of opposed jaws, at least one of said opposed jaws being moveable by manually operable means from a first open position spaced apart from said other jaw to a second closed position adjacent said other jaw, each of said jaws having a member to engage one portion of the body tissue, said jaws having means for holding the portions of body tissue in approximation when moved to their closed position; and

means adjacent said jaws for ejecting an elongated rod-like fastener into a path extending between said closed jaws.

35. A surgical apparatus of claim 34, wherein said means adjacent said jaws for ejecting an elongated rod-like fastener through a path extending between said closed jaws.

36. The surgical apparatus of claim 34, wherein said jaws are adapted to hold said portions of body tissue in at least partially overlapping waveform.

37. The surgical apparatus of claim 35 comprising means for defining the ejection path of said rod-like fastener.

38. The surgical apparatus of claim 34, wherein said means for holding the portions of body tissue in approximation comprises a pair of second gripping members on

one of said jaws, and at least one gripping member positioned on the other of said jaws which intersects at least partially between said pair of spaced gripping members when said jaws are moved to their closed position.

39. The surgical apparatus of claim 34, wherein said fastener ejecting means comprises an elongated rod movable longitudinally to eject said rod-like fastener into said path.

40. The surgical apparatus of claim 37, wherein said means for altering the path of said ejected rod-like fastener comprises an arcuate bore.

41. A surgical apparatus for attaching at least two adjacent opposed end portions of cutaneous body tissue, which comprises:

- a) a pair of opposed jaws movable toward and away from each other;
- b) body tissue engaging means extending from each jaw and facing the opposed jaw for engaging the respective opposed portions of the body tissue, such that when said jaws are moved toward each other said body tissue engaging means causes the two end portions of the body tissue to be displaced toward each other and engage at an engagement interface thereof so as to assume an irregular shape; and
- c) fastener storing means positioned proximal of said pair of opposed jaws for storing at least one generally elongated fastener, such fastener defining a generally longitudinal axis;
- d) means for advancing such at least one elongated fastener in generally the same direction as said longitudinal axis and generally medially of such body tissue engagement interface to thereby attach the opposed end portions of the body tissue.

42. The apparatus according to claim 41, wherein said storing means comprises a cartridge positioned adjacent said jaws and adapted to support a plurality of rod-like members.

43. An apparatus for attaching at least two adjacent end portions of cutaneous body

tissue defining an opening which comprises:

- a) a pair of opposed jaws movable toward and away from each other;
- b) body tissue engaging means attached to each jaw and facing the opposed jaw, said body tissue engaging means on each said jaw being configured, dimensioned, and relatively positioned such that when said jaws are respectively positioned against the end portions of the body tissue and said jaws are moved toward each other, said body tissue engaging means engage the end portions of the body tissue adjacent the opening and cause them to engage each other and to assume an undulating shape at the interface thereof;
- c) fastener storing means positioned proximal of said body tissue engaging means for storing at least one generally elongated attaching member; and d) means cooperative with said fastener storing means for directing such at least one elongated attaching member from a position generally medially and subcuticularly of the body tissue at such body tissue engagement interface to thereby attach the end portions.

44. The apparatus according to claim 43, wherein at least two elongated arms are connected to each other at one end portion and resiliently biased away from each other at the free end portion and said jaws are each respectively positioned at the free end portion of one of said arms.

45. The apparatus according to claim 44, wherein each jaw forms an obtuse angle with said respective elongated arm.

46. An apparatus for attaching at least two adjacent end portions of cutaneous body tissue defining an opening which comprises:

- a) first and second opposed jaws adapted to be selectively moved toward and away from each other;
- b) at least one generally pointed member extending away from said first jaw and generally toward said opposite jaw and at least two generally pointed members extending from said second jaw and generally toward said first jaw, whereby when said first and second jaws are respectively positioned against the end portions of the body tissue and said jaws are moved toward each other, said generally pointed

members of said jaws engage the end portions of the body tissue adjacent the opening and cause them to engage each other and to assume an undulating shape at the interface thereof;

c) means positioned proximal of said jaws for storing at least one generally elongated body tissue attaching member; and

d) means cooperative with said storing means for directing such at least one elongated body tissue attaching member generally medially and subcuticularly of the body tissue at such body tissue engagement interface to thereby attach the end portions.

47. The apparatus according to claim 46, wherein said two sharp pointed members are positioned in spaced relation on said second jaw and said first jaw includes said one sharp pointed member extending therefrom toward said second jaw at a location generally medially between said two sharp pointed members of said second jaw.

48. The apparatus according to claim 47, wherein said respective sharp pointed members are positioned for engagement with marginal end portions of the cutaneous body tissue adjacent an opening therein such that when said jaws are displaced toward each other, the body tissue portions move toward each other and into engagement and assume said undulating configuration at the interface therebetween.

49. The apparatus according to claim 48, wherein said storing means comprises a cartridge positioned adjacent said jaws and adapted to support a plurality of elongated body tissue attaching members.

50. The apparatus according to claim 49, wherein said cartridge includes means to resiliently bias said rod-like members toward a position for advancing the members distally toward the body tissue when the body tissue is gripped by said sharp pointed members.

51. The apparatus according to claim 50, wherein said body tissue attaching

members are constructed of a bioabsorbable material.

52. The apparatus according to claim 51, wherein each body tissue attaching member is a rod-like member having a sharp pointed tip at the distal end to facilitate subcuticular penetration of the body tissue.

53. The apparatus according to claim 52, wherein each rod-like member includes at least one slot extending at least partially around a peripheral portion thereof.

54. The apparatus according to claim 53, wherein each said rod-like member includes a plurality of partially annular slots extending over surface portions thereof.

55. The apparatus according to claim 54, wherein said slots are five partially annular cut-out portions on opposed sides of each said rod-like member to provide a discontinuous surface to said rod-like member to retain said rod-like member in position within the body-tissue due to the interface between the body tissue and said discontinuous surface.

56. The apparatus according to claim 55, wherein said cartridge includes means to resiliently bias said rod-like members toward a position for advancing a member distally toward the body tissue when the body tissue is gripped by said sharp pointed members.

57. A surgical apparatus for subcutaneously attaching two adjacent end portions of skin defining an opening, which comprises:

- a) a pair of elongated members connected at one end portion and having two opposed jaws respectively positioned at the free end portion, said members being resiliently biased away from each other and adapted to be moved toward and away from each other;
- b) at least two generally sharp skin engaging members attached to a first of said jaws and extending in a direction generally toward the second of said jaws;

- c) at least one generally sharp skin engaging member attached to said second jaw and extending in a direction generally toward the first jaw, said skin engaging members being relatively positioned such that when said jaws are opened and said members are positioned against the end portions of the skin adjacent an opening therein, and the jaws are moved toward each other with the two adjacent end portions of skin gripped therebetween, said generally sharp skin engaging members engage the marginal end portions of skin adjacent the opening and cause them to assume an undulating shape; and
- d) means movable toward said first and second jaws for advancing a fastener member into the body tissue.

58. The apparatus according to claim 57, wherein said two generally sharp skin engaging members are attached to said first jaw in spaced relation to each other and said one generally sharp skin engaging member attached to said second jaw is positioned generally medially of said skin engaging members on said first jaw.

59. A surgical apparatus for engaging first and second body portions which comprises:

- a) a pair of opposed jaws;
- b) at least two spaced apart tissue engaging means positioned on a first of said jaws and adapted to engage the first body tissue portion;
- c) at least one tissue engaging means positioned on a second of said jaws at a location generally between said first two tissue engaging means on said first jaw and adapted to engage the second body tissue portion, said jaws movable toward each other so as to approximate the first and second body tissue portions; and
- d) means movable toward said jaws for advancing fastener members generally between said jaws to attach the body tissue portions.

60. A surgical apparatus for engaging first and second spaced body tissue portions and advancing elongated fastener members, which comprises:

- a) a pair of opposed jaws;
- b) at least two spaced apart tissue engaging means positioned on a first of said jaws and adapted to engage one of the body tissue portions;

- c) at least one tissue engaging means positioned on said second jaw, said last mentioned tissue engaging means positioned with respect to said first two tissue engaging means on said first jaw such that when said tissue engaging means are respectively positioned in engagement with the body tissue portions, and said jaws are advanced toward each other sufficient to cause the tissue portions to engage each other, the tissue portions assume an irregular shape at the interface thereof, said jaws movable toward each other so as to approximate said first and second body tissue portions; and
- d) means movable toward said jaws for individually advancing elongated fastener members generally medially of said jaws to attach the body tissue portions.

61. A surgical apparatus for engaging first and second spaced body tissue portions and advancing fastener members, which comprises:

- a) a pair of opposed jaws;
- b) at least two spaced apart tissue engaging members positioned on a first of said jaws and adapted to engage one of the body tissue portions;
- c) at least one tissue engaging member positioned on said second jaw, said last mentioned tissue engaging member positioned with respect to said first two tissue engaging members on said first jaw such that when said tissue engaging members are respectively positioned in engagement with the body tissue portions, and said jaws are advanced toward each other sufficient to cause the tissue portions to engage each other, the tissue portions assume an irregular shape at the interface thereof;
- d) means for supporting said jaws to facilitate movement toward each other so as to approximate said first and second body tissue portions; and
- e) means movable toward said jaws for individually advancing fastener members from a position proximal of said jaws to a position between said jaws.

62. A surgical apparatus for engaging first and second body tissue portions and advancing a fastener member, which comprises:

- a) a pair of opposed jaws;
- b) at least two tissue engaging members positioned in spaced relation on a first of said jaws and extending in a direction generally toward said second jaw;

- c) at least one tissue engaging member positioned on a second of said jaws and extending generally in a direction toward said first jaw such that said tissue engaging members may be positioned in respective engagement with the body tissue portions and said jaws moved toward each other to move the correspondingly positioned body tissue portions toward each other therewith in engaged relation, said at least one tissue engaging member on said second jaw being positioned between said at least two tissue engaging members on said first jaw; and
- d) means positioned proximal of said jaws for advancing a fastener member into such engaged body tissue portions.

63. The apparatus according to claim 62, wherein such fastener member is elongated.

64. The apparatus according to claim 63 further comprising means to store a plurality of such elongated fastener members and said fastener member advancing means is adapted for individually advancing such fastener members.

65. A surgical apparatus for attaching at least two adjacent end portions of cutaneous body tissue, which comprises:

- a) a pair of opposed jaws movable toward and away from each other;
- b) means positioned proximal of said jaws for storing a plurality of skin attaching fasteners, said fasteners comprising a generally straight rod-like elongated member having a sharp pointed tip at the distal end to facilitate subcuticular penetration into the marginal end portions of cutaneous body tissue to retain the end portions together, said member having at least one at least partially annular slot extending over a peripheral portion thereof to prevent exit from the cutaneous body tissue; and
- c) body tissue engaging means extending from each jaw and facing the opposed jaw for engaging the respective opposed portions of the body tissue such that when the jaws are moved toward each other said engaging means causes the two end portions of the body tissue to be displaced toward each other and engage at the interface thereof so as to assume an irregular shape whereby said at least one

elongated member may be directed generally medially of such body tissue engagement interface to thereby attach the opposed portions of the body tissue.

66. An apparatus for attaching at least two adjacent end portions of cutaneous body tissue defining an opening which comprises:

- a) at least two elongated arms connected to each other at one end portion and resiliently biased away from each other at the free end portion;
- b) a jaw positioned at the free end portion of each of said arms and movable toward and away from each other when said arms are moved toward and away from each other;
- c) body tissue engaging means attached to each jaw and facing the opposed jaw, and being configured and dimensioned such that when said jaws are respectively positioned against the end portions of the body tissue and said jaws are moved toward each other, said body tissue engaging means engage the end portions of the body tissue adjacent the opening and cause them to engage each other and to assume an undulating shape at the interface thereof; and
- d) means movable toward said jaws to introduce and direct an elongated attaching member generally medially and subcuticularly of the body tissue at the interface to thereby attach the end portions.

67. A surgical fastening apparatus which comprises:

- a) a pair of jaws, each of said jaws having means for gripping a body tissue portion, said jaws movable toward each other to move the body tissue portions toward each other;
- b) fastener storing means positioned adjacent said pair of jaws and storing at least one elongated fastener; and
- c) means cooperative with said fastener storing means for introducing and directing said at least one elongated fastener into the body tissue portions at a location such that contact between said fastener and said jaws is avoided.

68. The surgical fastening apparatus according to claim 67, wherein said pair of jaws are normally biased away from each other.

69. The surgical fastening apparatus according to claim 67, wherein said gripping means comprises at least one sharp pointed member extending from each of said jaws.

70. The surgical fastening apparatus according to claim 67, wherein said fastener directing means comprises a member having a distal surface adapted to contact a proximal surface of said at least one fastener.

71. The surgical fastening apparatus according to claim 67, wherein said fastener storing means is configured to store a plurality of fasteners in stacked relation.

72. The surgical fastening apparatus according to claim 67, wherein said at least one fastener is composed of a bioabsorbable material.

73. A surgical fastening apparatus which comprises:

- a) a pair of jaws, each of said jaws having means for gripping a body tissue portion, said jaws being supported by support means and movable toward each other to move the body tissue portions toward each other into engagement;
- b) means positioned adjacent said jaws for storing a plurality of elongated rod-like fasteners in generally vertically stacked relation; and
- c) means cooperative with said fastener storing means for contacting and directing a bottommost fastener of said plurality of stacked fasteners into such engaged body tissue portions.

74. A surgical fastening apparatus which comprises:

- a) a first tissue gripping member;
- b) a second tissue gripping member;
- c) means for moving at least one of said tissue gripping members towards said other tissue gripping member;
- d) fastener storing means positioned proximal of said tissue gripping members and storing at least one elongated fastener, said elongated fastener defining a generally longitudinal axis; and
- e) means for advancing said at least one elongated fastener into the tissue in

generally the same direction as said longitudinal axis after at least one of said tissue gripping members is moved towards the other member.

75. The surgical fastening apparatus according to claim 74, wherein said first and second gripping members each comprise at least one sharp pointed member.

76. The surgical fastening apparatus according to claim 75, wherein said at least one sharp pointed member on said first and second gripping members extends inwardly.

77. The surgical fastening apparatus according to claim 74, wherein said elongated fastener has a pointed tip.

78. The surgical fastening apparatus according to claim 74, wherein said fastener storing means comprises a cartridge for supporting a plurality of elongated fasteners in stacked relation.

79. The surgical fastening apparatus according to claim 74, wherein said fastener directing means is adapted to come into contact with a proximal end of said fastener to direct it subcuticularly into the tissue.

80. The surgical fastening apparatus according to claim 74 further comprising means for biasing said first and second gripping members away from each other.

81. The surgical fastening apparatus according to claim 74, wherein said at least one fastener is composed of a bioabsorbable material.

82. An apparatus for attaching at least two adjacent end portions of cutaneous body tissue defining an opening which comprises:

- a) first and second elongated arms connected to each other at one end portion and adapted to be selectively moved toward and away from each other, said elongated arms resiliently biased away from each other at the free end portions thereof;
- b) first and second opposed jaws respectively positioned at the free end portions of

said first and second elongated arms, and forming an obtuse angle with said respective elongated arm, said first jaw including at least one sharp pointed member extending away from said jaw and generally toward said opposite jaw, said second jaw including at least two sharp pointed members extending therefrom and generally toward said first jaw, whereby when said first and second jaws are respectively positioned against the end portions of the body tissue and said jaws are moved toward each other, said pointed members of said jaws engage the end portions of the body tissue adjacent the opening and cause them to engage each other and to assume an undulating shape at the interface thereof;

c) means spaced from said jaws for storing at least one generally elongated attaching member; and

d) means adapted to cooperate with said storing means for directing said at least one elongated attaching member generally medially and subcuticularly of the body tissue at such body tissue engagement interface to thereby attach the end portions.

83. A surgical apparatus for attaching at least two adjacent end portions of cutaneous body tissue, which comprises:

a) a pair of opposed jaws;

b) means for supporting said jaws for movement toward and away from each other;

c) means spaced from said pair of opposed jaws for storing at least one generally elongated fastener member;

d) body tissue engaging means extending from each jaw and facing the opposed jaw for engaging the respective opposed portions of the body tissue, one of said jaws having a greater number of body tissue engaging means than said other jaw, said body tissue engaging means being respectively configured, dimensioned and relatively positioned such that when said jaws are moved toward each other said body tissue engaging means causes the two end portions of the body tissue to be displaced toward each other and engage at the interface thereof so as to assume an irregular shape; and

e) means movable for engagement with such elongated fastener member for directing such at least one elongated member generally medially of such body tissue engagement interface to thereby attach the opposed portions of the body tissue.

84. A surgical apparatus for attaching at least two end portions of cutaneous body tissue adjacent an opening in the body tissue, which comprises:

- a) first tissue gripping member;
- b) second tissue gripping member positioned opposite and movable toward said first tissue gripping member;
- c) at least one elongated tissue fastening member supported proximal of said tissue gripping members; and
- d) a pusher engagable with said at least one elongated tissue fastening member for advancing said at least one elongated tissue fastening member into the body tissue without substantial deformation by said tissue fastening member.

85. A surgical apparatus for attaching at least two end portions of cutaneous body tissue adjacent an opening in the body tissue, which comprises:

- a) first tissue gripping member;
- b) second tissue gripping member movable toward said first tissue gripping member such that engagement of said first and second tissue gripping members with the respective end portions of cutaneous body tissue and movement of said first and second tissue gripping members toward each other causes the end portions to move toward each other to form an irregular surface at the interface thereof;
- c) at least one elongated fastener member supported proximally of said gripping members; and
- d) a pusher proximal of said tissue gripping members and engagable with said at least one elongated fastener member for advancement of an elongated fastening member longitudinally with respect to the opening in the body tissue.

86. A surgical apparatus for attaching two portions of body tissue, which comprises:

a pair of opposed jaws each having a member to engage one portion of the body tissue, means supporting said jaws for moving at least one of said jaws toward the other jaw to move said body tissue portions toward one another; a chamber supported proximally of said jaws for holding a plurality of rod-like members; and a plurality of rod-like members disposed in said chamber, each rod-like member being elongated and of sufficient length to penetrate said body tissue portions when drawn together, each rod-like member further being substantially rectangular in

cross-section.

87. A surgical apparatus as recited in claim 86, wherein each said rod-like member comprises a distal end having a tapered tip having a sharp point for penetrating the body tissue and a proximal end.

88. A surgical apparatus as recited in claim 87, wherein said chamber is dimensioned to receive and support said rod-like members in a stacked relationship.

89. A surgical apparatus as recited in claim 88, further comprising means for driving said rod-like members outwardly from said chamber into the body tissue.

90. A surgical apparatus as recited in claim 87, further comprising an indentation formed adjacent said proximal end of each said rod-like member to restrict linear movement after insertion into the body tissue.

91. A surgical apparatus as recited in claim 87, wherein said rod-like members are composed of a bioabsorbable material.

92. A surgical apparatus for attaching at least two portions of body tissue, which comprises:

- a) a pair of jaws respectively supported in opposed relation, each jaw having a member to engage one portion of the body tissue, at least one of said jaws movable toward the other jaw to move the body tissue portions toward one another;
- b) a chamber for supporting a plurality of rod-like members, said chamber disposed and supported proximally of said jaws, each said rod-like member being of sufficient length to penetrate the two body tissue portions when drawn together, each said rod-like member having a cross-sectional configuration to facilitate stacking of said rod-like members in contacting relationship; and
- c) a pusher movable within said chamber for advancing said rod-like members into the at least two body tissue portions without substantial deformation thereof.

93. A surgical apparatus as recited in claim 92, wherein each said jaw is respectively supported so as to be movable toward and away from the opposed jaw to move said body tissue portions toward one another to a position wherein said body tissue portions are drawn together in close approximation, and wherein each said rod-like member is individually movable to penetrate said body tissue portions when drawn together in close approximation.

94. A surgical apparatus as recited in claim 93, wherein each said rod-like member has at least one substantially planar surface which extends longitudinally along said rod-like member, whereby said rod-like members are laterally stacked along said longitudinally extending planar surfaces to form a stacked arrangement.

95. A surgical apparatus as recited in claim 94, wherein said rod-like members are stacked laterally in surface-to-surface contact.

96. A surgical apparatus as recited in claim 94, wherein said cross-sectional configuration of each said rod-like members is square.

97. A surgical apparatus as recited in claim 94, wherein said cross-sectional configuration of each said rod-like members is hexagonal.

98. A surgical apparatus as recited in claim 92, wherein said rod-like member is of substantially circular cross-section.

99. A surgical apparatus for attaching two portions of body tissue, which comprises: a pair of opposed jaws, each jaw having a member adapted to engage one portion of the body tissue, at least one of said jaws movable towards the other jaw to move the body tissue portions toward one another; and a plurality of rod-like members disposed and supported proximally of said jaws, each said rod-like member being of sufficient length to penetrate the two body tissue portions when drawn together, each said rod-like member having a rectangular cross-sectional configuration to facilitate stacking of said rod-like members; and a pusher engageable with said rod-like members for advancing said rod-like members into the body tissue portions.

100. A surgical apparatus as recited in claim 99, wherein each rod-like member includes at least three planar outer surfaces extending longitudinally therealong.

101. A surgical apparatus as recited in claim 99, wherein each rod-like member is of sufficient rigidity to substantially retain said substantially straight elongated shape upon insertion into body tissue.

102. A surgical apparatus for attaching two portions of cutaneous body tissue, which comprises:

a pair of opposed jaws, each jaw having a member to engage one portion of the body tissue, at least one of said jaws movable toward the other jaw to move the body tissue portions toward one another; and a plurality of rod-like members disposed and supported proximally of said jaws, each said rod-like member being of sufficient length to penetrate the two body tissue portions when drawn together, each said rod-like member having a side portion adapted to cooperate with a side portion of an adjacent rod-like member to facilitate lateral stacking of said rod-like members; and a pusher engageable with said rod-like members for advancing said rod-like members into the body tissue portions.

103. A surgical apparatus as recited in claim 102, further comprising an indentation formed in said distal end of said rod-like member to restrict linear movement of said rod-like member after insertion into the body tissue.

104. A surgical apparatus as recited in claim 102, wherein said rod-like members have a substantially straight elongated shape and are of sufficient rigidity to substantially retain said substantially straight elongated shape upon insertion into body tissue, said rod-like members each defining a longitudinal axis extending therethrough, and applied to the body tissue in general alignment with said longitudinal axis.

Fig.1

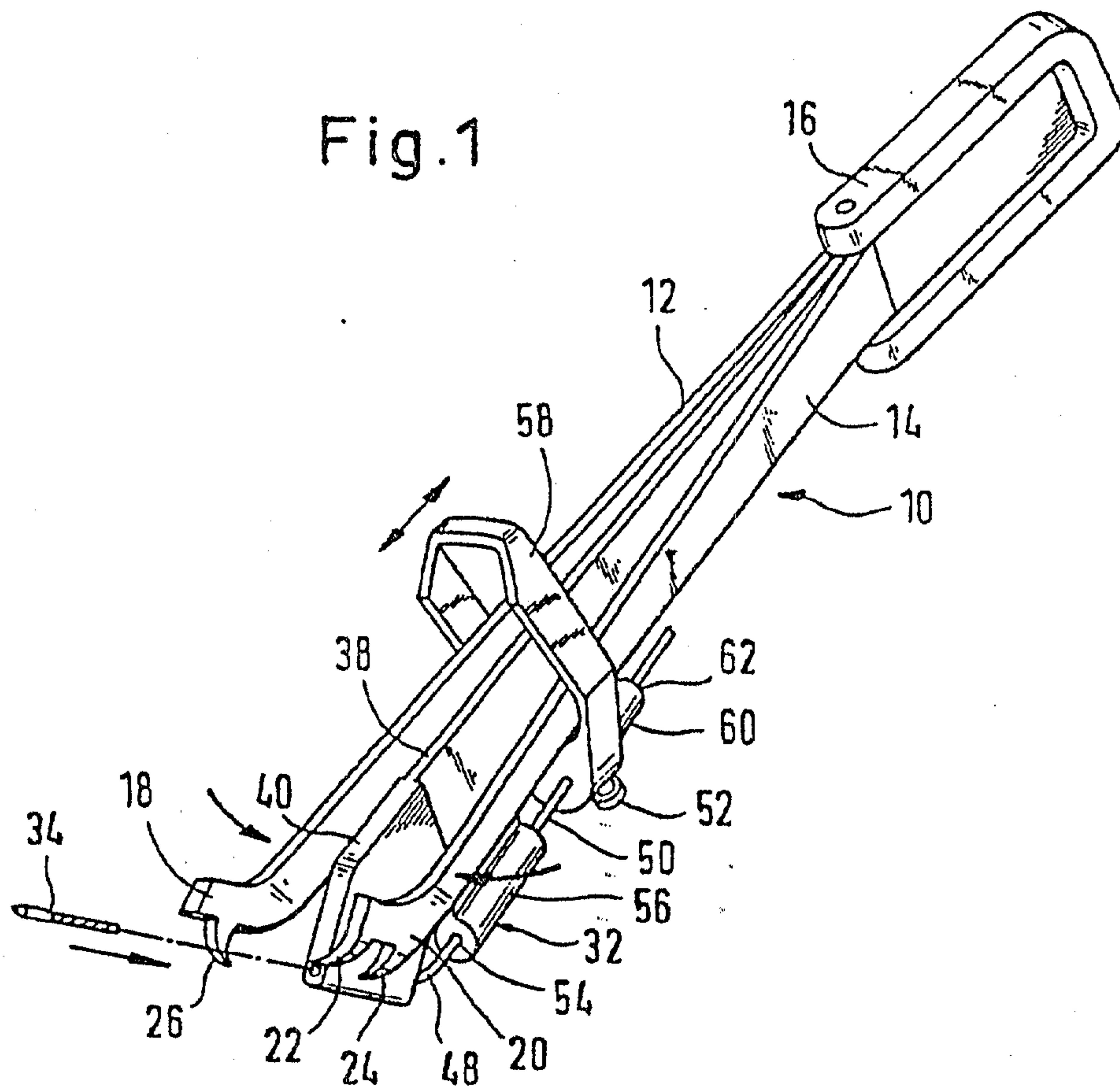


Fig.2

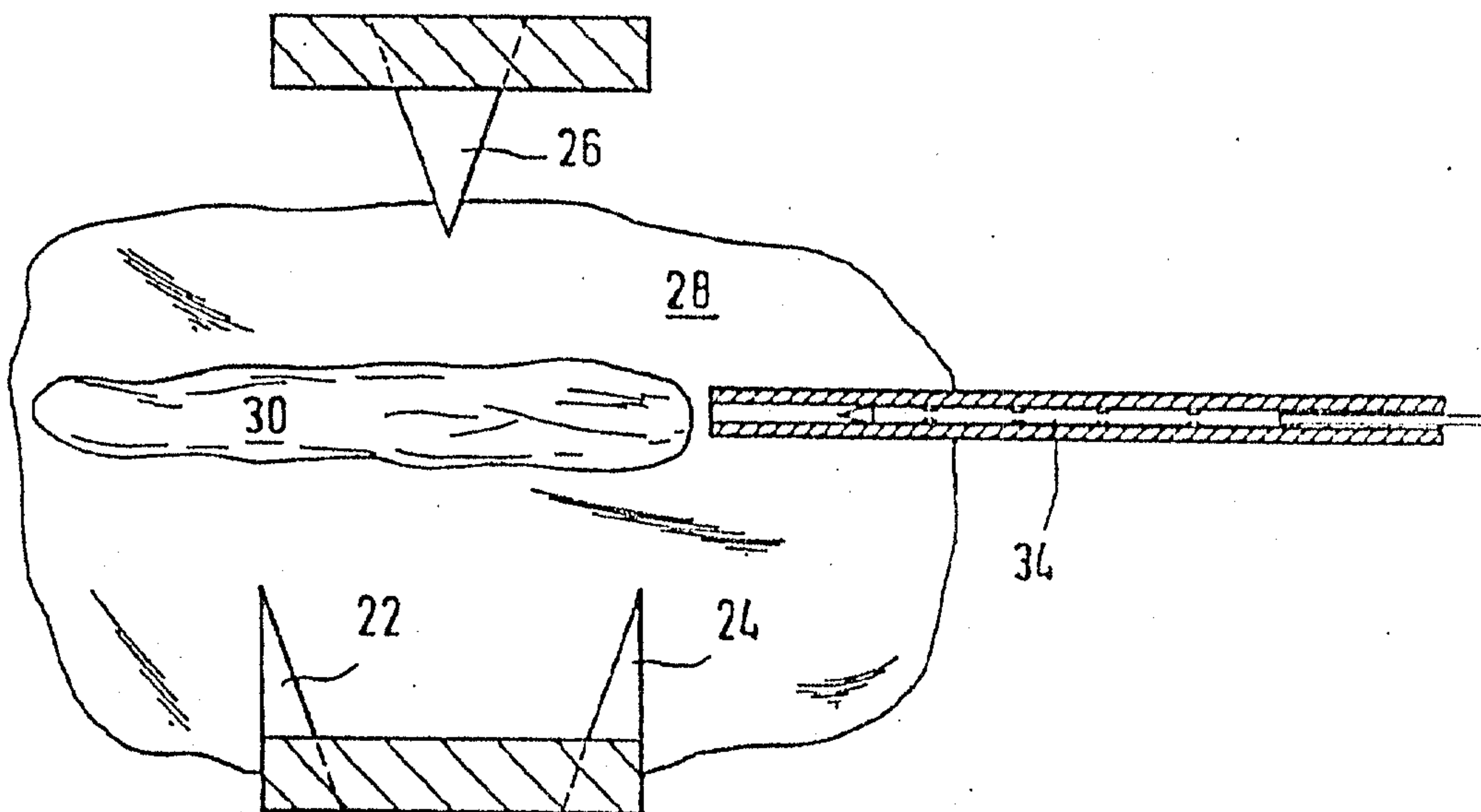


Fig. 3

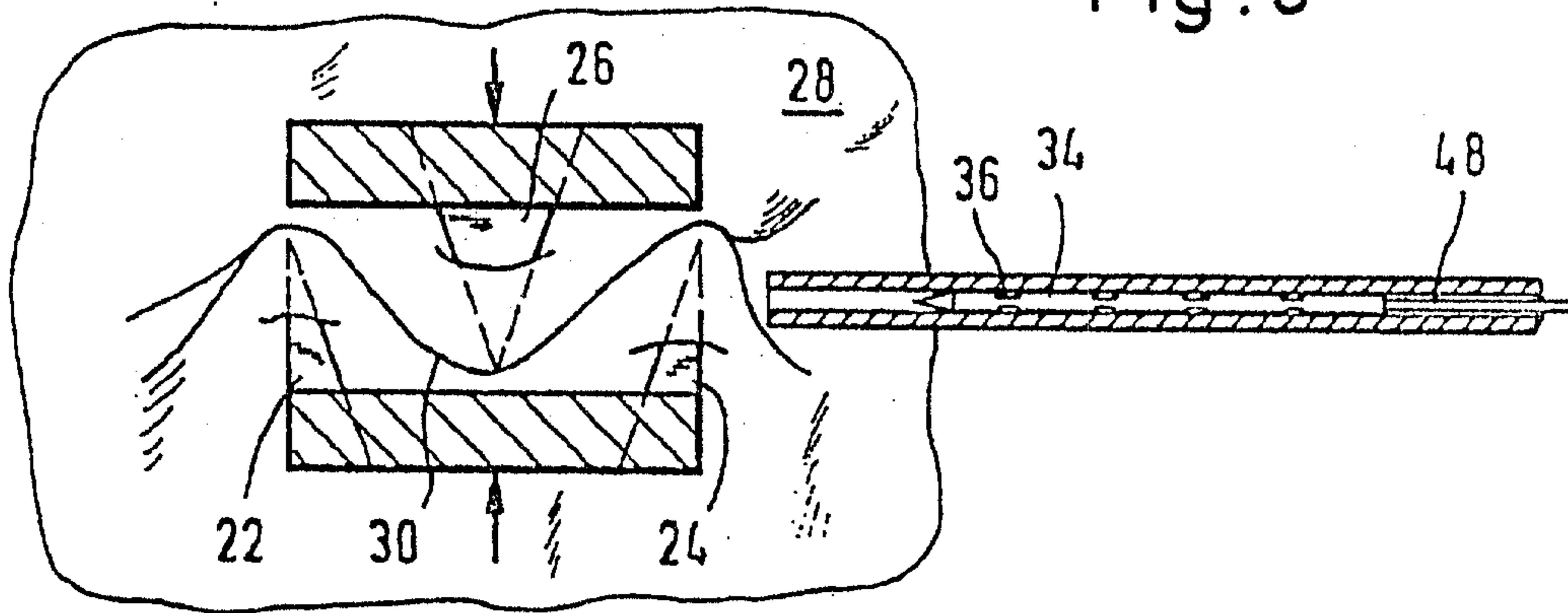


Fig. 4

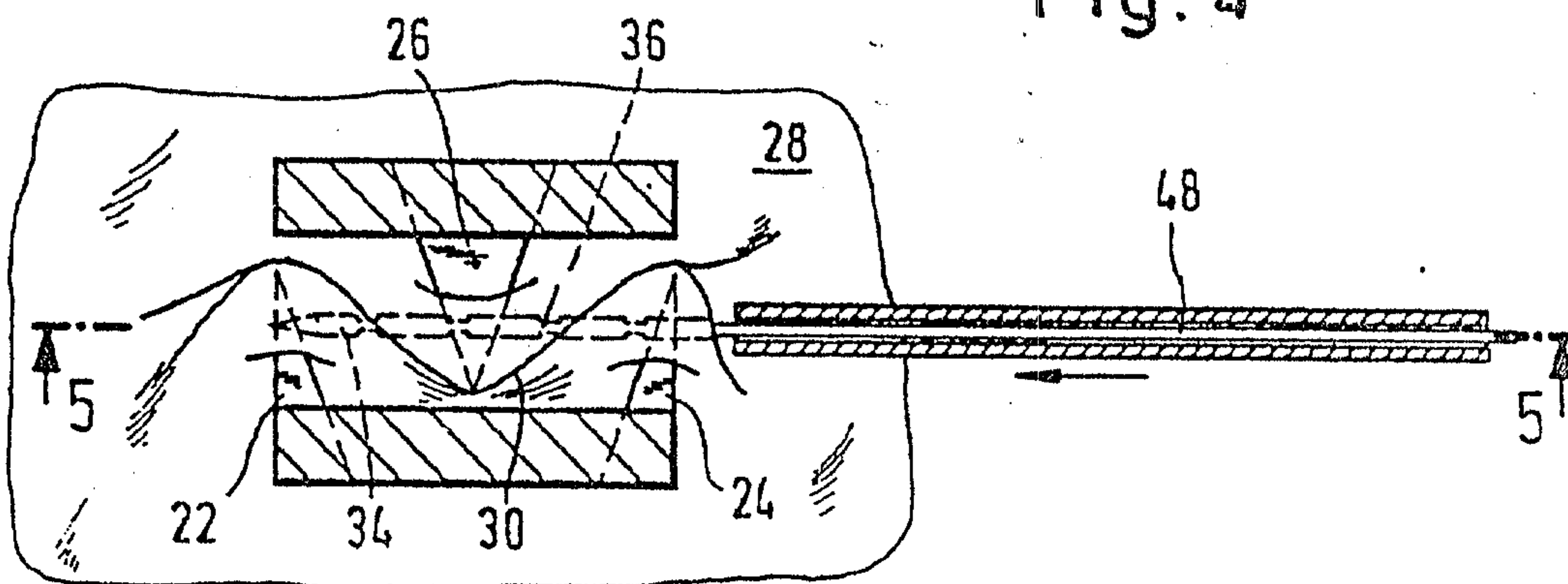


Fig. 5

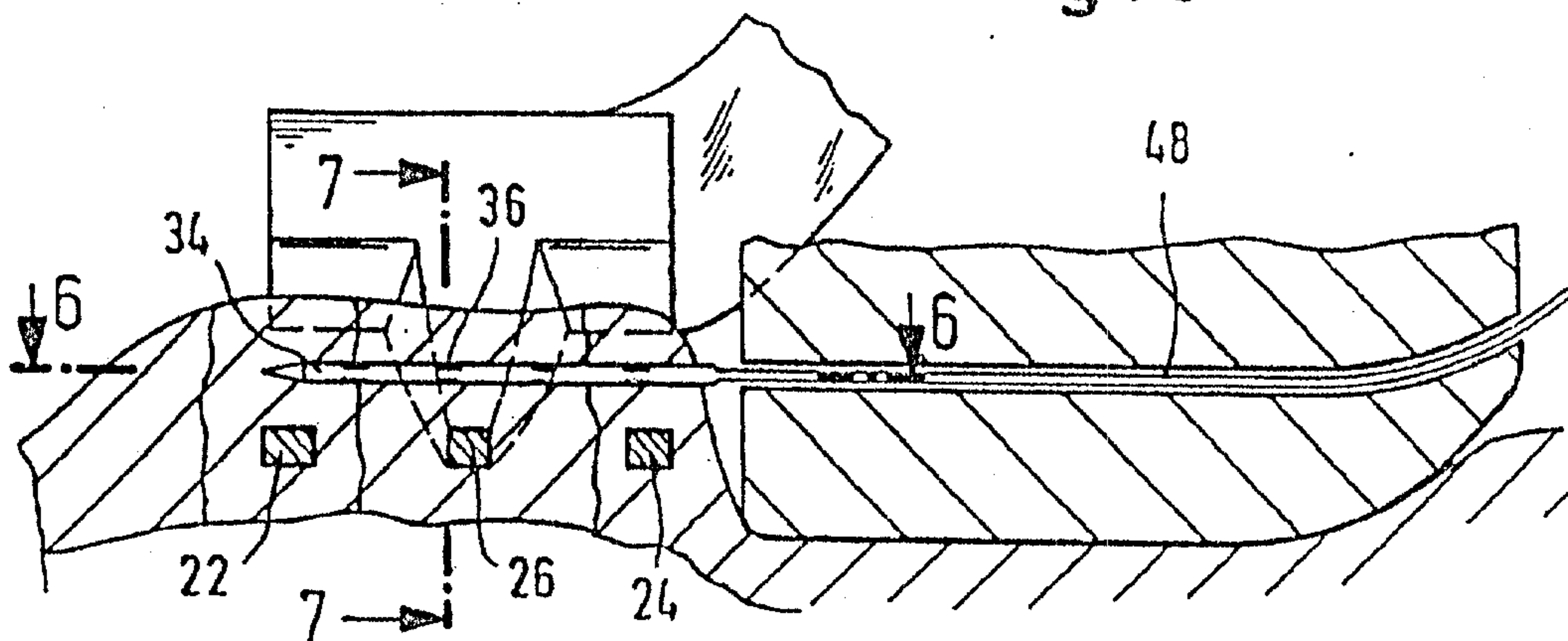


Fig. 6

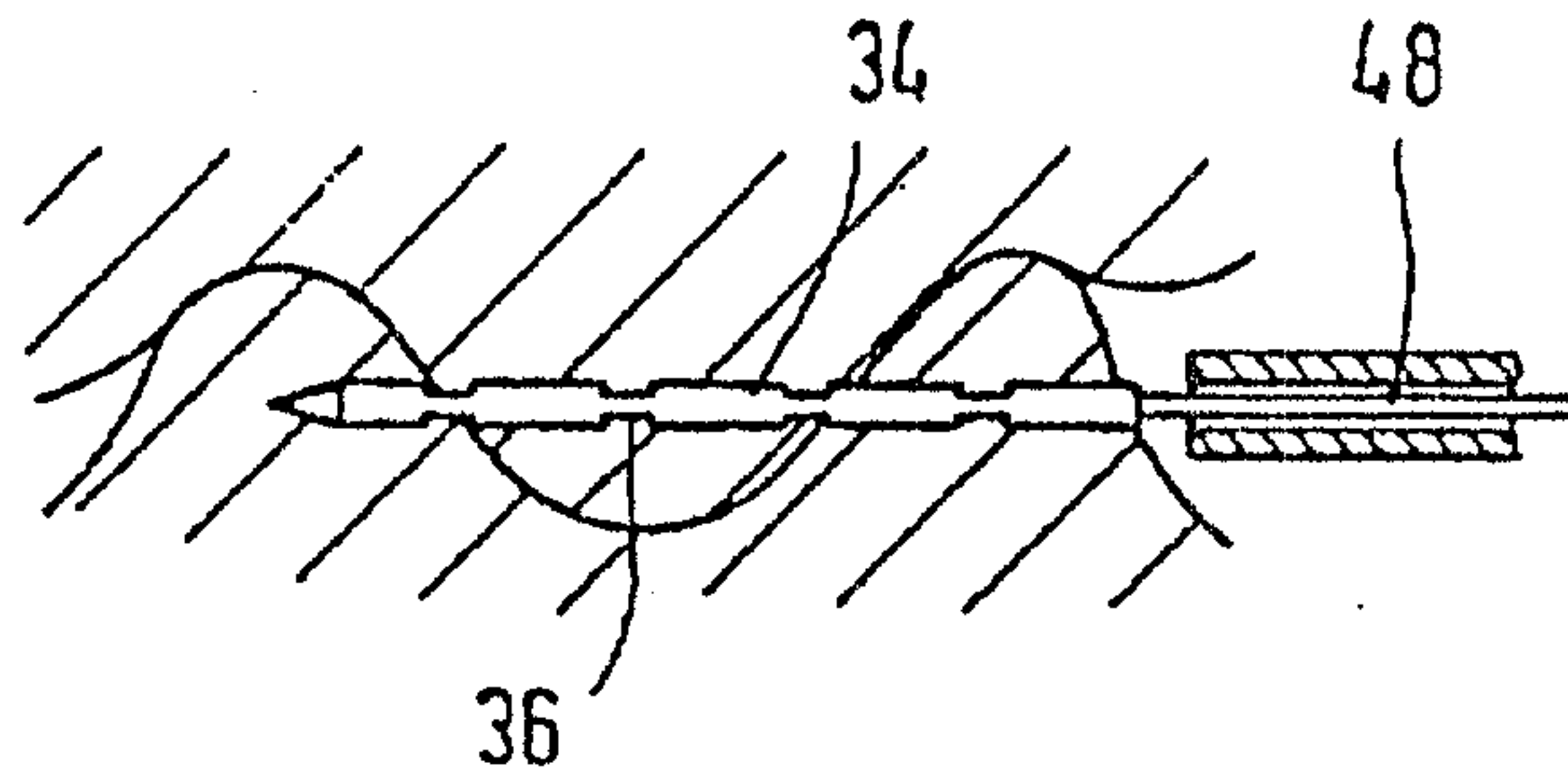


Fig. 7

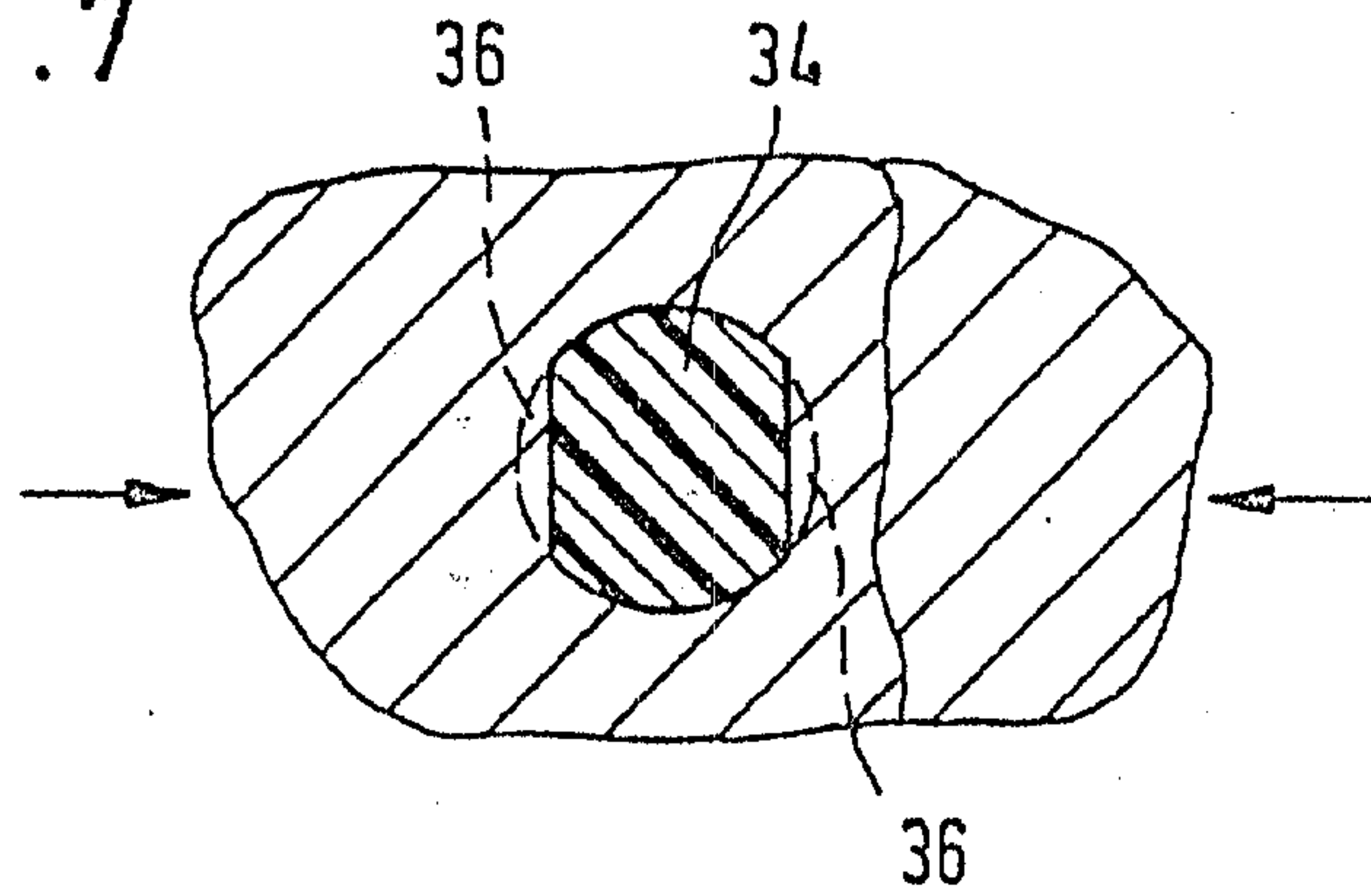


Fig. 8

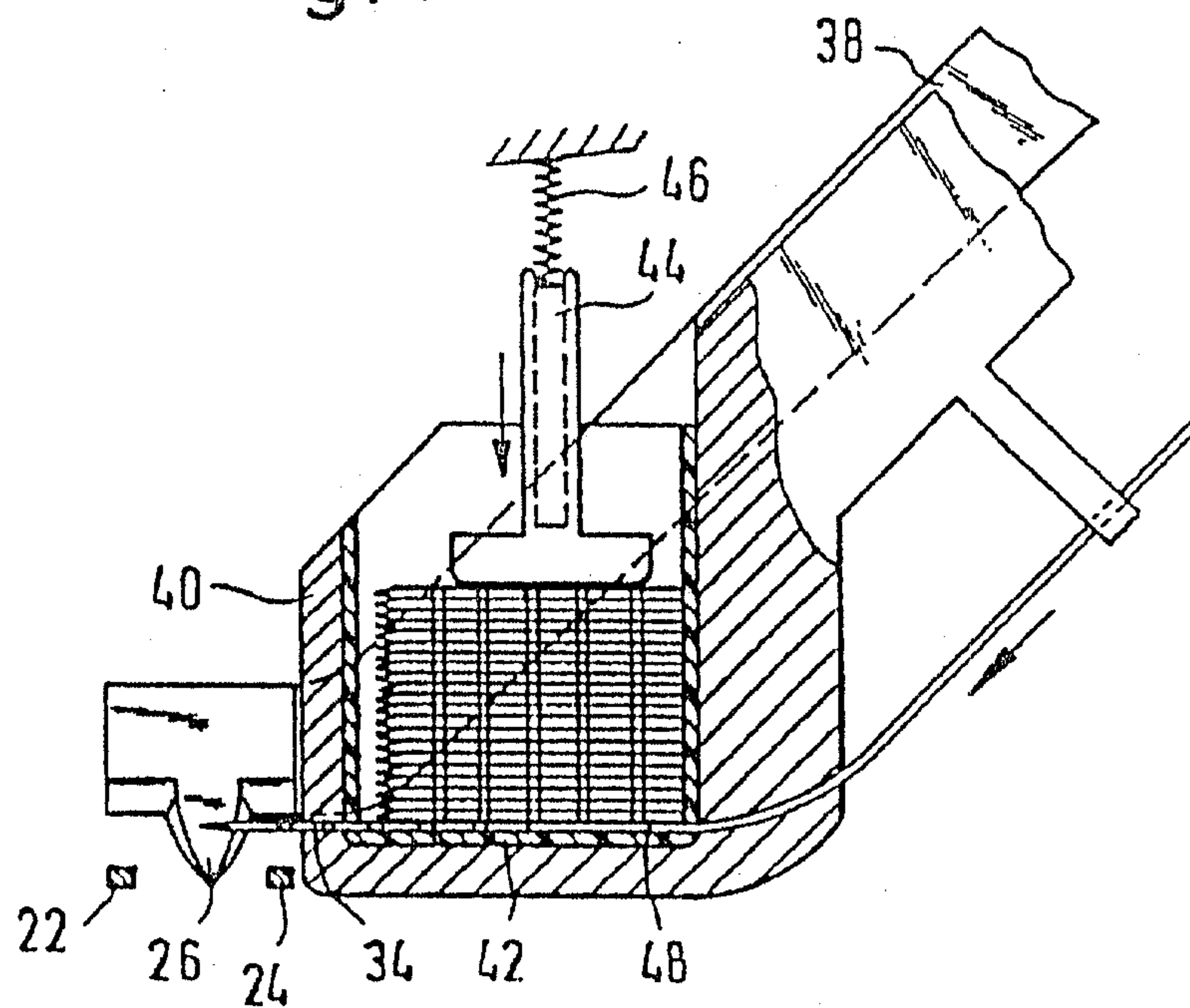


Fig. 9

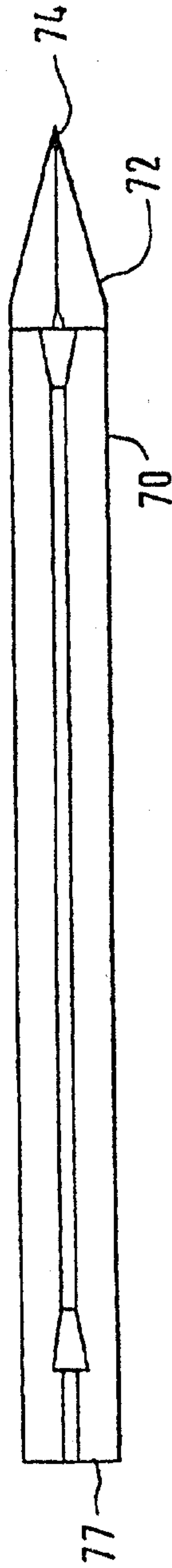


Fig. 10

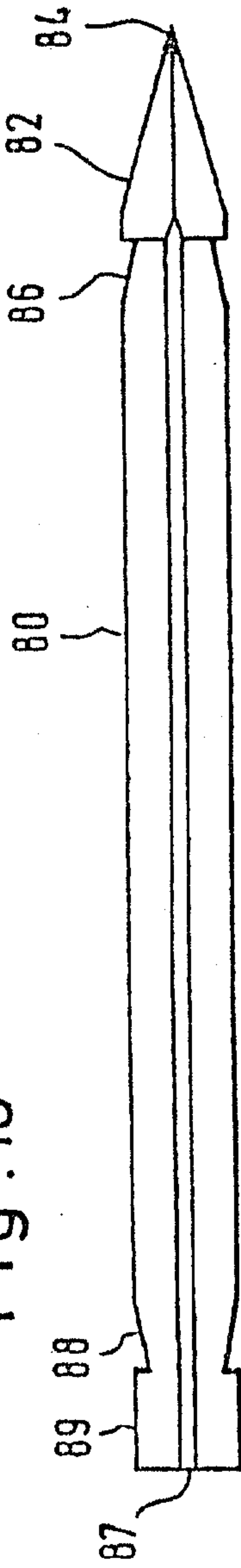


Fig. 11

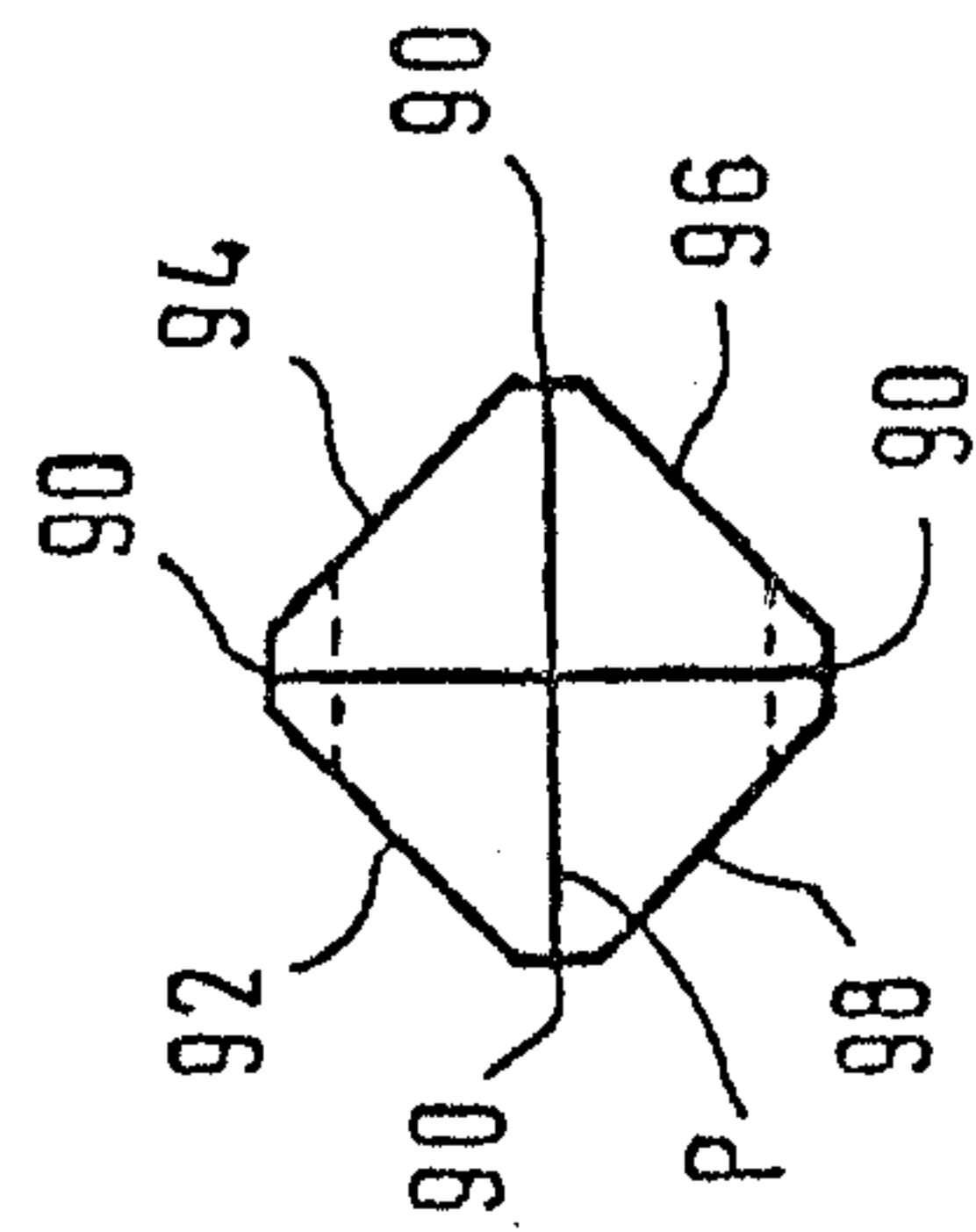


Fig. 12

