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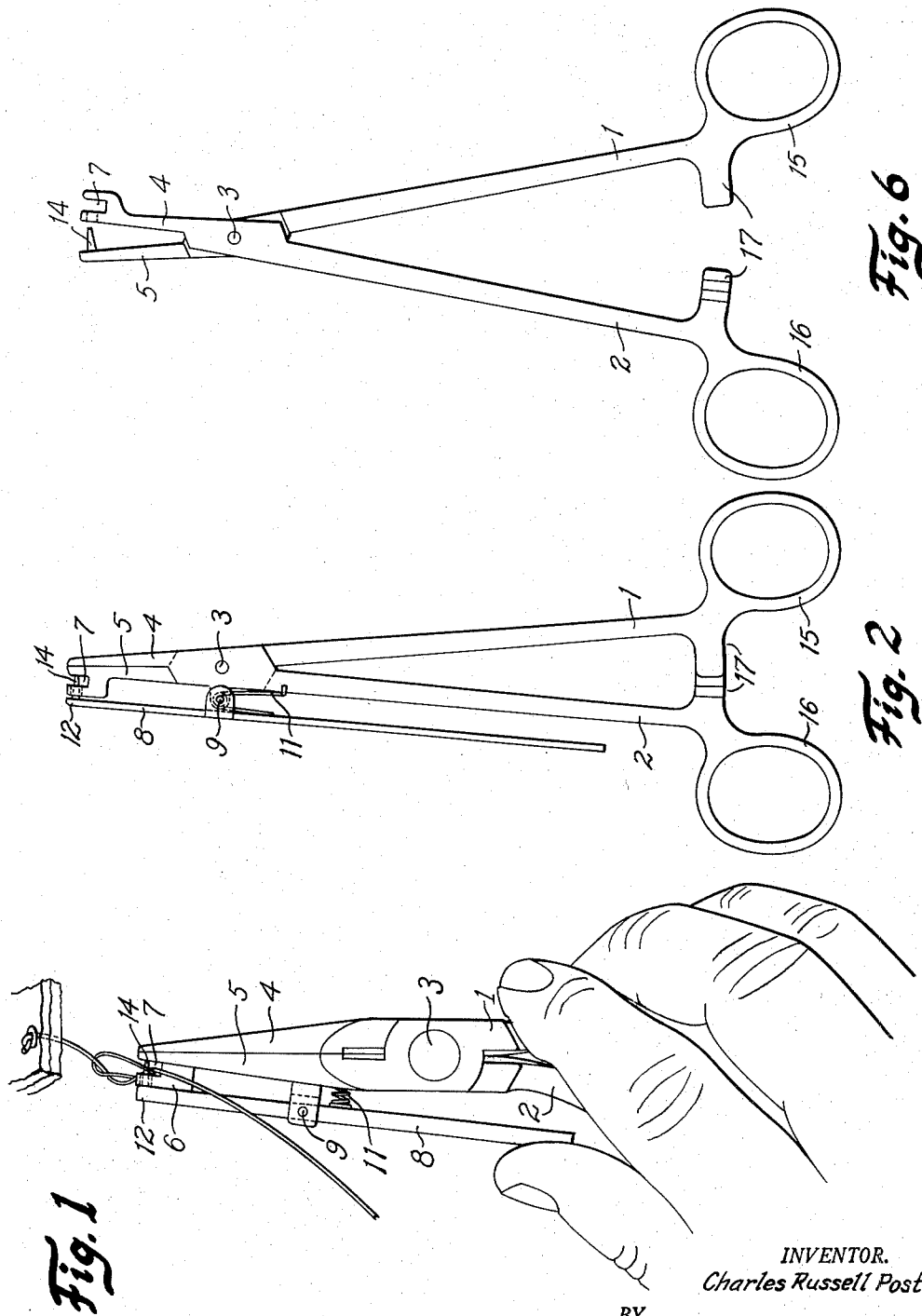
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2,895,478

SUTURE-TYING INSTRUMENT

Filed March 18, 1954

2 Sheets-Sheet 1



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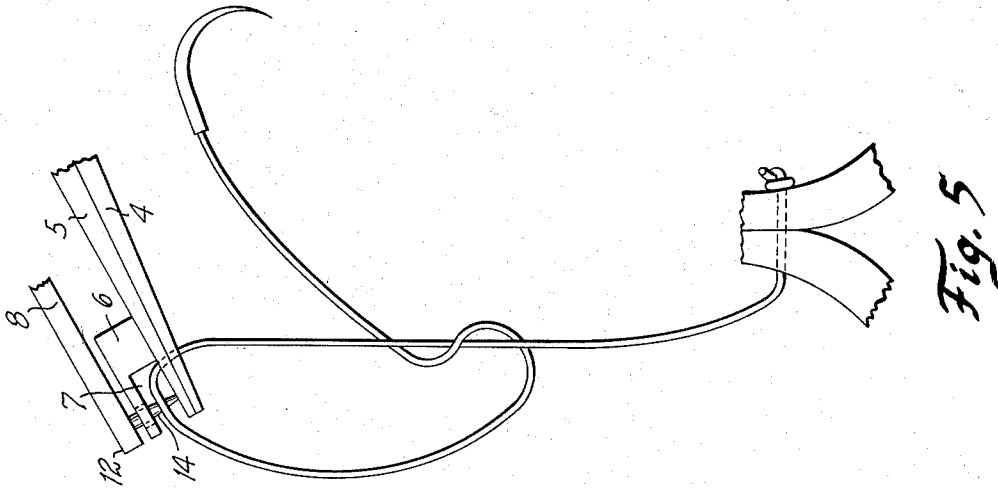


Fig. 5

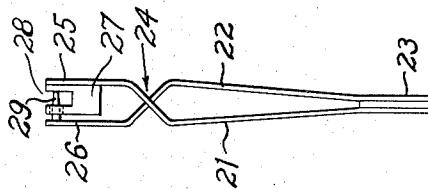


Fig. 3

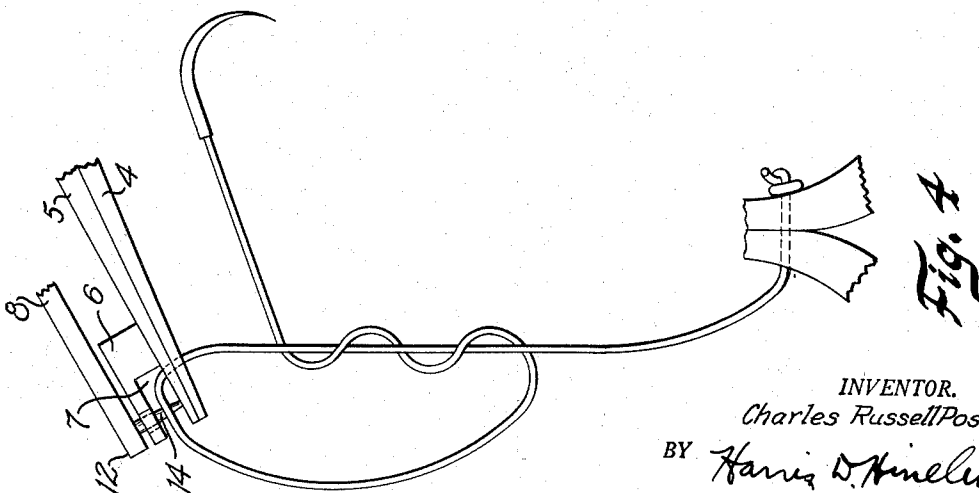


Fig. 4

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SUTURE-TYING INSTRUMENT

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3 Claims. (Cl. 128—334)

The invention here presented is a suture-tying instrument adapted to use by a surgeon for the placing of stitches or sutures after accidental injury or surgical intervention by which a loop is formed behind a withdrawable pin and the needle end of the suture thread passed either once or twice through the loop, according to the material used, whereafter the knot is pushed up closely against the tissues by pushing the instrument down against the tissues and simultaneously pulling on the needle end of the suture thread to produce a tight, non-opening knot in the suture close to the tissues but without undue tension tending to pull the knot through the tissues.

In any surgery it is of the essence that the incisions shall be closed and held closed by stitches, and a wide variety of materials is offered to the surgeon for use as suture threads, including gut threads, silk threads, cotton threads, and many other filaments. Usually the needle is swaged onto the end of the suture thread so that there is always but a single thread, without doubling, and usually the needle is curved or bent. In using this device, a sizeable or substantial knot is thrown on the free end of the thread, by making a loop and passing the end once or twice through the loop, cutting off the excess thread beyond the knot. The needle may then be passed through the tissues which are to be held together, drawing the knot on the free end of the thread up to the tissues, but the forming of the second knot, close to the tissue surface but without undue tension on the tissues, is much more difficult, so much so that the ability to tie a tight knot close to the tissues is the distinguishing characteristic between a skilled surgeon and an unskilled one.

Because of the difficulty of producing the second knot with proper tension, most surgeons, especially the relatively inexperienced ones, prefer to draw the ends of the thread together and form a square knot over the edges of the tissues to be joined. This, however, is only slightly less difficult and a square knot can slip under even minor tension, especially when the thread is moist gut.

The present invention provides a simple tool for tying the second knot when a single strand of thread is to be passed through the tissues and knotted at each end, in the use of which a loop is first formed manually in the soft, moist suture thread and the needle end, with or without the needle attached, passed once or twice through the loop, depending upon the thread material; then a removable pin on the end of a push-rod passing between jaws is inserted in the loop, positioned close to the tissues, and the thread pulled tight, reducing the loop to the size of the pin, whereupon the pin is moved slightly and tension maintained on the knot to draw it tight, necessarily very close to the tissues or, if the pin is pushed down firmly against the tissues, the knot can be formed practically under the tissue surface, whereafter the excess thread is cut off leaving a tight, non-slipping knot close to or practically in the tissue surface.

By the device and process of the present invention, it is found possible to tie a knot deep in a wound without the necessity of passing the surgeon's fingers into the wound,

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and the knot can be placed as tightly or as loosely as is desired without difficulty, and the knoter may be used as a separate tool, or may readily be made a part of a needle holder as desired. The device is conveniently usable for the production of successive separate stitches, or a series of continuous stitches may be formed with knots on each side of each pass through the tissues. Also, the removable pin in the knoter may be withdrawn enough to be inserted within the loop of thread, but it usually is preferable to pass the needle behind the withdrawable pin, since the procedure is more certain in the hands of a surgeon and is closely similar to the procedure of passing the needle through the tissues and the similarity is helpful under the stress of surgical work. Other objects and details of the invention will be apparent from the following description when read in connection with the accompanying drawings, wherein:

Fig. 1 is a side view of the device incorporated in a pliers type of needle holder and shows the method of operation and the formation of loop and knot;

Fig. 2 shows the device applied to a standard type of needle holder;

Fig. 3 shows a tweezer type of knoter as a single, simple, instrument, independent of needle holders;

Fig. 4 is a diagrammatic showing of the formation of a two-pass knot;

Fig. 5 shows a diagrammatic representation of the formation of a single pass knot; and

Fig. 6 shows a modified form of a knoter and needle holder.

Referring to Figs. 1 and 2, the first form of knoter consists of a pair of plier type lever members 1 and 2 hinged on a pivot 3 with jaws 4 and 5 suitable for holding a needle. On one side of the jaw 5 there is provided a notched block 6 having a cut-out portion which forms a recess 7 with the plier jaw 5. A knotting lever 8 is provided and carried on a pivot 9 attached to the jaw 5. A spring member 11 is likewise provided pushing the handle end of the lever 8 outward to bring the active end 12 of the lever 8 against the block 6. A pin member 14 attached to the active end 12 of the lever 8 passes through a hole in the block 6 and into the recess 7 between block 6 and the plier jaw 5. Ample space is allowed between the pin 14 and the bottom of the recess 7 for the largest suture thread which will be used, and the pin 14 is brought as close to the end of the plier jaw 5 as is structurally convenient.

In the operation of this embodiment, a knot is manually placed in the end of the suture thread in the usual manner, this probably being by the throwing of a loop in the suture and the passing of the end through that loop twice, which is most conveniently done by rolling the two threads where they cross to make the loop, between thumb and finger; then by tension on the thread on opposite sides of the loop a tight, non-slipping loop is produced. The needle may then be grasped between the plier jaws 4 and 5 and held firmly therein by manual pressure on the holders 1 and 2, whereupon the needle may be passed through the tissues which are to be sutured, the projecting end of the needle grasped by the pliers and drawn through bringing the suture thread with it until the knot on the end is snugly against the under side of the tissues. The needle may then be passed behind the withdrawable pin in the suture-tying instrument to form a similar loop as in tying the first knot and the needle end passed twice through the loop as before, the needle and all being allowed to pass through to produce the loop necessary to form the knot. The needle end of the suture thread may then be held above the tissues being sutured to bring a small amount of tension onto the loop, whereupon a downward movement of the instrument will bring the withdrawable pin to the bottom of the loop and further

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downward movement towards the suturable tissues will carry the loop downward until the bottom of the loop is in contact with the tissues. Meanwhile, an appropriate tension upon the needle end of the thread will reduce the size of the loop until, as the withdrawable pin brings the bottom end of the loop against the tissues, the size of the loop may be reduced to barely enough to encircle the withdrawable pin. The handle end of the lever 8 is then depressed, withdrawing the pin 14 from the recess 7 and leaving a tight knot in place. Alternatively, the loop may be formed without the aid of the knotting instrument and the needle end passed twice through the loop, whereupon the pin 14 may be withdrawn from the recess 7 and the double thread portion of the loop brought to the bottom of the recess 7 and the lever 8 released, whereupon the spring 11 brings the pin 14 to the bottom of the recess 7 and within the loop which is to form the knot. The needle may then be grasped by fingers or another needle holder and the whole drawn out straight but without substantially reducing the size of the knot. Downward movement of the jaws 4 and 5 of the needle holder will carry the pin 14 in the recess 7 down towards the tissues, during which movement light tension on the needle end of the suture will reduce the size of the loop as it approaches the surface of the tissues. The needle holder jaws, recess 7, and pin 14 may be brought down into contact with the suture surface or may be gently pressed into the suture surface according to the tightness desired in the loop, and further tension on the needle end of the suture thread draws the loop down to the stage where it is tightly held against the pin 14. The pin may then be withdrawn slowly with tension on the knot, whereupon the loop is completely closed as the pin 14, which is preferably tapered to a needle point, is withdrawn, resulting in a mechanically produced knot, mechanically placed with exactly the right tension or spacing against the sutured tissues. The thread may then be cut off as close to the knot as seems desirable to the surgeon and a new knot formed in the end preparatory to the next suture, whereupon the procedure is repeated until a sufficient number of sutures is placed or the available amount of suture thread is exhausted and a new needle and thread are required.

It may be noted that, when a moist, slippery thread such as gut is used, the needle must be passed twice through the loop to get a tight, non-slipping knot, as is shown in Fig. 4, whereas, if silk or other threads which do not become slimy from the presence of moisture are used, a satisfactory knot may be obtained by passing the needle only once through the loop.

It will be observed that this device is readily sterilized and is simple, not subject to breakage or failure, and that it ties a wholly satisfactory knot the equal of the best tied by any surgeon.

Referring to Fig. 2, an alternative embodiment is shown utilizing a standard needle holder, in which the same numbers indicate corresponding parts to the embodiment of Fig. 1, except that the members 1 and 2 are terminated in finger rings 15 and 16 and latching members 17 are provided as a convenience in holding the needle during insertion. The method of operation is substantially identical in every respect.

In some instances it is desired to have the knotter separate from the needle holder, and such an embodiment is shown in Fig. 3. In this embodiment, standard tweezers consisting of spring members 21 and 22 welded together at the outer ends in a weld 23 (or riveted, screwed, or otherwise fastened together) are provided. As usual, these members 21 and 22 cross at an intersection 24 to yield tweezer ends 25 and 26. To one of the tweezer ends there is fastened a block member 27 having a recess 28. To the other tweezer end 26 there is attached a pin member 29.

In the operation of this embodiment the procedure is

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substantially identical with that of the previously described embodiments. The initial loop and knot are formed in the end of the suture thread as usual, the needle is inserted into the tissues, and the first knot drawn up to the proper place. A similar loop is then formed as before and the needle end passed twice through the loop. When this is done, the handle members 21 and 22 of the tweezer structure are pressed together, thereby withdrawing the pin 29 from the recess 28, whereupon the doubled portion of the loop is inserted into the recess and the pin 29 allowed to return under the spring pressure of the tweezer members 21 and 22 to bring the pin 29 within the loop. The suture is then drawn out straight as before and the tweezer member carried downward along the line of the suture thread into contact with or adjacent to the tissues, during which movement light tension on the needle end of the thread will reduce the size of the loop, until, as the tweezers reach the tissues, the loop is drawn down almost to the diameter of the pin 29. Further tension on the suture and simultaneous leisurely withdrawal of the pin 29 permits the tightening of the knot to any desired degree, whereupon the pin may be fully retracted and the tweezers removed, leaving the knot as close to the tissue surface as desired.

Still another embodiment of the invention is presented in Fig. 6. It is found that the presence of the knotter pin between the needle holder jaws does not interfere with the use of the standard needle holder, and accordingly it is conveniently possible to put the pin member at the end of one needle holder jaw, bore a hole through the other needle holder jaw to permit passage of the pin, and provide the auxiliary member on the outside of the second jaw to form a notch for entrance of the knotter pin as above described.

Accordingly, in the operation of this embodiment, the needle is seized between the jaws of the needle holder in the usual way, passed through the tissues, released, and seized by the needle holder on the other side of the tissues, and drawn through together with the thread. The needle is then released, passed through the notch behind the knotter pin as previously described, and a loop formed as before with one or two passages through the loop to provide an appropriate knot which is then pushed down to the tissues as previously described.

By the structure and process of the invention it is thus possible to tie, mechanically, a very high grade knot in a suture thread and simultaneously to place it as close to the tissue surface as desired in as deep an incision as may be needed with such tension or lack of tension as may be indicated.

While there are above disclosed but a limited number of embodiments of the apparatus and process of the present invention it is possible to provide still other embodiments without departing from the inventive concept herein disclosed, and it is therefore desired that only such limitations be imposed on the appended claims as are stated therein or required by the prior art.

The invention claimed is:

1. A combined needle holder and knotter comprising, in combination, a pair of plier levers, one thereof having in the end thereof a recess parallel to the length of the plier jaws and an auxiliary member pivoted on one plier jaw, one end thereof having a pin passing into said notch, the other end being adapted to manual manipulation.

2. A combined needle holder and knotter comprising, in combination, a pair of plier levers, one thereof having in the end thereof a recess parallel to the length of the plier jaws and an auxiliary member pivoted on one plier jaw, one end thereof having a pin passing into said notch, the other end being adapted to manual manipulation, the plier members having finger loops.

3. A combined needle holder and knotter comprising, in combination, a pair of plier levers, one thereof having, in the end thereof, a recess parallel to the length of the

plier jaws and an auxiliary member pivoted on one plier jaw, one end thereof having a pin passing into said notch, the other end being adapted to manual manipulation, the plier members having finger loops and locking ratchets.

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