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### SURGICAL CUTTING NEEDLE

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*Fig. 1.*

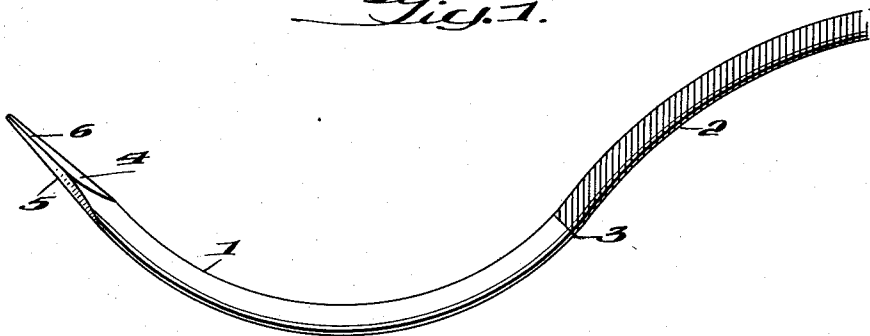
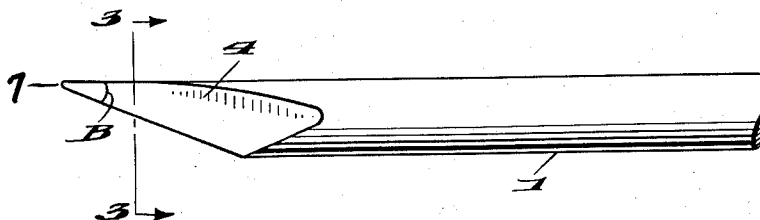


Fig. 2.



*Fig. 3.*



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## SURGICAL CUTTING NEEDLE

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This invention relates to a surgical instrument and more particularly to a suturing needle which has improved piercing qualities.

In my co-pending application Serial No. 557,326 filed January 4, 1956, for Surgical Needle, now Patent No. 2,869,550 issued January 20, 1959, it is clearly set forth that the angle of slope and the sharpness angle of the point of the needle are critical factors and must lie within a predetermined range. As demonstrated in the previous application, decreasing the angle of slope increases the sharpness of the needle. Greatly improved results could be obtained provided the angle was not decreased to such an extent that there was insufficient metal at the point to give structural support.

In previous needle designs it was found that the slope angle could not be decreased below 20° when the sharpness angle was approximately 35°. This was due to the fact that at slope angles of less than 20° the metal at the point became so thin that it tended to bend and thus form a burr. Since the decrease in the angle of slope reduces the force required to penetrate tissue to a considerable extent, it would be highly desirable to decrease this angle if means could be found to avoid the burr formation referred to hereinbefore.

The present invention provides a means whereby the angle of slope can be decreased to a substantial extent below 20° and yet the point of the needle is maintained with sufficient strength to prevent the formation of burrs. It would normally be expected that the actual point of the needle would play a major role in determining the overall sharpness of the needle. That is to say, one would expect that the more pointed the needle, the sharper the needle and that consequently less force would be required for penetration. However, surprisingly enough, it has been found that by decreasing the angle of slope and by removing the tip of the needle which lacks sufficient structural strength so that, in effect, the needle is blunted, a sharper needle is provided which requires less force for penetration. It has been established that the actual point of the needle has a piercing quality independent of other factors and that this can be reduced to a certain extent without adversely affecting the overall piercing qualities of the needle. That is to say, a needle may have a slope angle which requires a penetration force of 3.5 oz. whereas the needle point may require only 1.0 oz. Thus, the slope angle may be decreased to decrease the force of penetration required and the needle point may be removed so as to increase its overall penetration efficiency and, therefore, provide a more efficient overall needle.

An object of the present invention is to provide a surgical cutting instrument which has a considerably reduced penetration force characteristic.

Another object of the present invention is to provide a surgical needle or the like with an angle of slope less than previous needle designs so that a considerably sharper needle is provided without any sacrifice in strength characteristics.

Still another object of the present invention is to provide a surgical needle with an angle of slope less than that used heretofore and in which the point of the needle is removed so as to prevent the formation of burrs and the like.

Other objects and many of the attendant advantages of

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the present invention will become apparent upon consideration of the following detailed specification when taken in connection with the accompanying drawing wherein:

FIG. 1 is a perspective view of a surgical needle made in accordance with the present invention;

FIG. 2 is an enlarged view of the point of the needle shown in FIG. 1; and

FIG. 3 is a sectional view along the line 3—3 of FIG. 2.

Referring now to the drawing wherein like numerals indicate like parts throughout the several views, there is shown at 1 in FIG. 1 a surgical needle to which surgical thread 2 is attached at 3 by any suitable means such as by swaging. The thread may also be retained by drilling the end of the needle and inserting the thread and squeezing the needle and thread together. The point of the needle is provided with two flat faces as shown at 4 and 5 so that there is provided a single cutting edge 6 which extends laterally when the needle is in use. It is, of course, possible to orient the cutting edge in any desired plane or to provide the point of the needle with three flat faces and a plurality of cutting edges.

However, by having the cutting edge of the needle laterally disposed with the flat faces on the upper and lower surfaces of the needle, the possibility of tearing tissue is minimized. Furthermore, by forming the point and the two flat surfaces by a grinding operation it is assured that no larger diameter than the diameter of the round portion of the needle will be present in the point.

The angle which is identified as the angle B in FIG. 2 is termed the angle of slope. This angle determines the rate at which the tissues are cut to the diameter of the needle. The angle shown as angle C in FIG. 3 is termed the sharpness angle. This angle actually determines the sharpness of the lateral cutting edge. It can be readily appreciated that the smaller the angles B and C are, the sharper the needle point is but that as these angles are decreased the amount of metal at the point of the needle is reduced and eventually there is insufficient metal at the point to give the required strength characteristics and burrs will form when the needle is used or manufactured. It has been found that the angle of slope is even more of a critical factor in the penetration efficiency of the needle than is the sharpness angle. That is to say, reduction in the angle of slope causes a greater effect on the penetration force required than does a similar change in the angle of sharpness. As pointed out hereinbefore, however, practically speaking the angle of slope could not be decreased below 20° for the reason that needles having a lower slope angle do not possess sufficient strength.

It has been found that the angle of slope may be decreased to a substantial extent below the 20° lower limit or prior art needles and yet provide a needle having sufficient strength characteristics. This has been achieved by grinding off the tip of the needle as shown at 7 in FIG. 2. By removing the end portion of the needle there is no possibility of burr formation and yet the advantages of a low slope angle are retained. This point can be removed so that an arc like surface is provided as the entering portion of the piercing instrument as opposed to the point of prior art instruments. The inclusion angle or angle formed between tangents drawn to the outer portions of the arc like surface should be limited to 45°, but may be as high as 180°.

Experiments have been conducted in which the puncture force of needles was computed for various angles of slope when the point has been ground to an arc like configuration. The following is the results of these experiments:

Needle	B	I		II		III		IV		V		VI	
		X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
1.....	15	2.75	2.64	3.00	3.52	2.75	3.52	3.00	3.96	3.00	4.40	5.00	9.24
2.....	15	2.50	3.52	2.75	3.74	2.75	3.96	3.00	4.40	3.00	5.28	4.75	8.36
9.....	15	2.50	2.64	2.75	3.08	3.00	3.30	3.25	3.52	3.00	4.84	5.00	9.24
10.....	15	2.50	2.64	2.75	3.08	2.75	3.30	3.00	3.74	3.00	4.40	5.00	7.92
13.....	15	2.50	2.20	3.00	3.52	3.00	3.52	3.00	3.52	3.25	3.96	lost	
14.....	15	2.50	2.64	3.00	3.52	3.00	3.52	3.00	3.74	3.00	3.96	4.25	7.92
15.....	15	2.50	2.64	3.00	3.52	3.25	3.74	3.25	3.96	3.25	4.40	4.50	9.24
17.....	15	2.50	2.20	2.75	3.30	3.00	3.52	3.25	3.52	3.00	3.96	4.50	6.60
22.....	15	2.50	2.64	2.75	3.52	3.00	3.96	3.25	4.18	3.00	6.16	5.00	7.04
24.....	15	2.25	2.64	2.75	3.30	3.00	3.30	3.00	3.52	3.00	3.96	lost	
25.....	15	2.25	2.20	2.50	3.08	3.00	3.52	3.00	3.96	3.00	3.96	3.00	5.28
3.....	17	2.50	2.64	2.75	3.08	2.75	3.08	3.25	3.52	3.00	3.96	4.50	10.56
4.....	17	2.50	3.08	2.75	3.52	3.00	3.74	3.25	3.74	3.25	4.40	4.50	8.36
5.....	17	2.50	3.08	3.00	3.52	3.00	3.74	3.00	3.96	3.00	5.28	5.00	10.56
6.....	17	2.75	2.64	3.00	3.08	3.00	3.52	3.50	3.74	3.25	4.15	4.50	8.36
7.....	17	2.50	2.64	2.75	3.08	3.00	3.30	3.00	3.74	3.00	4.84	5.00	8.80
8.....	17	2.75	3.52	3.25	3.52	3.25	3.52	3.50	3.96	3.25	5.28	4.75	10.56
11.....	17	2.50	2.64	3.00	2.86	3.00	3.08	3.25	3.74	3.25	3.52	5.50	7.92
12.....	17	2.50	2.64	2.75	3.52	3.00	3.74	3.25	3.96	3.25	4.40	5.75	8.36
16.....	17	2.50	2.64	2.75	3.08	3.00	3.30	3.25	3.52	3.25	4.40	5.25	8.80
18.....	17	2.50	2.64	2.75	3.08	3.00	3.52	3.25	3.96	3.00	4.40	4.00	7.92
19.....	17	2.25	2.64	3.00	3.30	3.00	3.52	3.25	3.52	3.25	4.40	5.50	9.24
20.....	17	2.25	3.08	2.75	3.52	3.00	3.52	3.00	3.74	3.00	4.84	4.10	8.36
21.....	17	2.50	2.64	2.75	3.08	3.00	3.30	3.00	3.52	3.00	3.96	5.00	8.36
23.....	17	2.50	2.64	2.75	3.30	3.00	3.30	3.25	3.52	3.25	4.40	4.25	8.36
26.....	17	2.50	3.08	2.75	3.30	3.25	3.96	3.00	4.40	3.00	4.84	5.50	9.68
27.....	17	2.50	2.64	2.75	3.08	3.00	3.96	3.00	3.96	3.25	4.18	4.75	7.04
28.....	17	2.50	3.52	3.00	3.74	3.00	3.74	3.00	3.96	3.00	4.40	5.25	7.04
30.....	17	2.50	3.52	2.75	3.74	point bent							
29.....	19	2.50	2.64	3.00	3.08	3.25	3.52	3.25	3.96	3.50	4.40	5.50	7.04

X represents the puncture force in ounces, B the angle of slope in degrees and Y the blunted tip in thousandths of an inch.

It can be seen that the puncture force can be reduced to a figure as low as 2.50 oz. (In additional work, it has been possible to reduce this figure to as low as 1.50 oz.) This presents a 30% improvement over prior art needles such as disclosed in my co-pending application Serial No. 557,326, now Patent No. 2,869,550 and represents a significant advance in the art. It can also be seen that when the point is removed to too great an extent the puncture force increases appreciably. The effective operating limits of the width of the needle point extends from .0001 to .010 inch.

Thus it can be seen that there has been provided a surgical instrument such as a needle in which the penetration force required has been considerably reduced by decreasing the angle of slope and removing the point so as to form an arc like entering portion on the instrument. A surgical needle made according to the present invention provides substantially improved results without any sacrifice in strength characteristics.

Obviously many modifications and variations of the present invention are possible in light of the above teachings. What is claimed as new and desired to be secured by Letters Patent is:

1. A surgical instrument comprising a member having at least one cutting edge, said cutting edge formed by intersecting planar surfaces, said surfaces converging to-

wards an end portion, the angle of convergence comprising an angle of slope and being less than 25°, the end portion being arc shaped and having a width within the range of .0001 to .010 inch.

2. A surgical needle having a curved end portion, a cutting edge formed by a pair of intersecting planar surfaces, the cutting edge being laterally disposed with respect to the inner and outer curved surfaces, the planar surfaces converging towards the needle end, the angle of convergence being less than 25°, the needle end being arc shaped and having a width within the range of .0001 to .010 inch.

3. A surgical needle according to claim 2 wherein the angle of inclusion between tangents to the arc shaped needle end is greater than 45°.

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