Feb. 19, 1957 A. R. BAER 2,781,760

SURGICAL INSTRUMENT

Filed May 17, 1955

FIG. 1

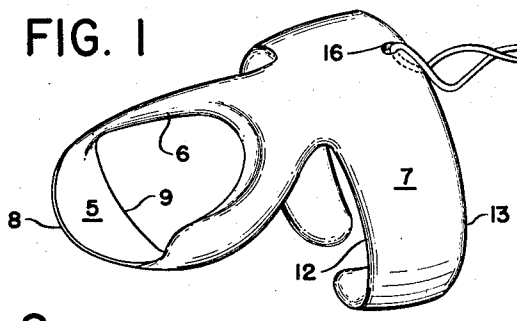


FIG. 5

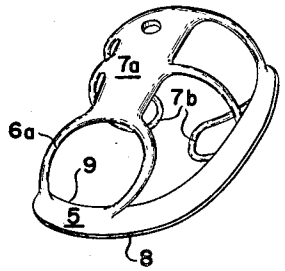


FIG. 2

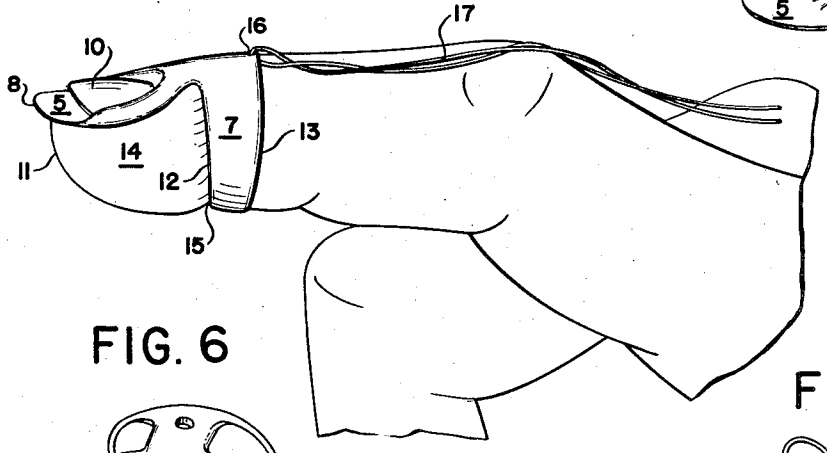


FIG. 6

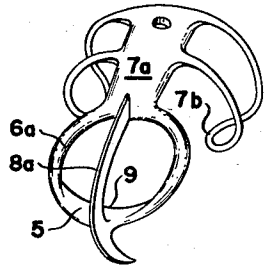
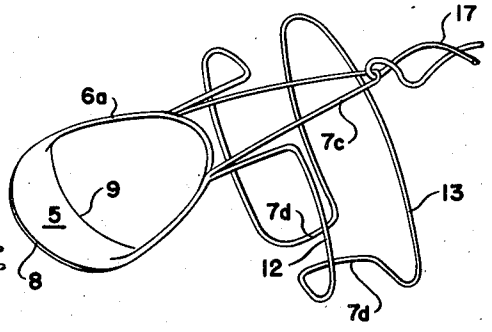


FIG. 4



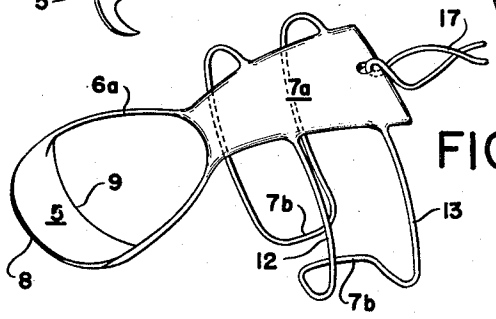


FIG. 3

INVENTOR
Austin R. Baer
BY
Pennie, Edmonds, Morton, Barrow & Taylor
ATTORNEYS

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2,781,760

SURGICAL INSTRUMENT

Austin R. Baer, New York, N. Y.

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10 Claims. (Cl. 128—303)

This invention relates to a surgical instrument and, more particularly, to an instrument for use in mitral valve surgery.

In surgery for the purpose of opening a stenotic mitral valve in the human heart, it is the present practice for the surgeon to insert his index finger into the interior of the heart and to explore by palpation. The anterior commissure of a stenotic mitral valve tends to form a fine, curved, grooved line extending from the anterior portion of the stenotic orifice to the myocardial wall. This fine line is the landmark which the surgeon uses to guide the splitting of the stenotic valve. In many instances the surgeon finds that the valve may be split merely by finger pressure, but in many other cases it is found that a cutting instrument is needed to open the stenotic valve. The use of a cutting instrument for this purpose is extremely hazardous inasmuch as the cutting instrument must be guided by the surgeon's finger while completely out of sight within the interior of the heart, and inasmuch as the surgeon's finger is required for guiding the cutting instrument his finger is not available for simultaneous palpation.

Surgical instruments have been suggested heretofore which have consisted of a finger ring or sleeve portion and a projecting knife blade or other implement such as the curette described in United States Patent No. 622,386. However, the instruments of this type are limited to a degree of sensitivity and control commensurate with variations in pressure of the finger ring or sleeve portion on the finger surface. This degree of sensitivity is inadequate for many modern surgical purposes, and for this reason such instruments have not met the constant need for a finger-borne instrument which will retain the sensitivity of which the human finger is capable.

I have now devised a surgical instrument which is characterized by a remarkable degree of sensitivity, so sensitive, in fact, that it is particularly useful in mitral valve surgery where simultaneous delicate cutting and digital palpation are required. The surgical instrument of my invention comprises a substantially crescentic blade adapted to fit under the surgeon's fingernail and into the recess formed by the nail and the quick. A supporting frame is provided with its ends engaging and supporting the crescentic blade, and a finger-ring portion is secured to the supporting frame and is adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail. In its embodiment as a surgical knife particularly adapted for mitral valve surgery, the outer edge of the crescentic blade is shaped to project beyond the edge of the fingernail and is sharpened to provide a cutting blade, but for other purposes the sharpened forward edge may be replaced by any other appropriate implement formed integrally with or secured to the crescentic blade.

These and other novel features of the surgical knife of my invention will be more readily understood by reference to the accompanying drawings in which:

Fig. 1 is a perspective view of the knife;

Fig. 2 is a side elevation of the knife mounted on a finger; and

Figs. 3, 4, 5 and 6 are perspective views of modifications of the knife construction shown in Fig. 1.

The surgical instrument shown in Fig. 1 comprises a crescentic blade 5 the ends of which are supported by a yoke-shaped supporting frame 6. The frame is in turn secured to or formed integrally with a finger-ring portion 7 shaped to engage the distal phalanx of a surgeon's finger and thus hold the blade in position at the extremity of the finger.

The crescentic blade 5, in the specific embodiment of the invention shown in Fig. 1, is provided with an outer edge portion 8 sharpened to form a cutting edge which advantageously slopes downwardly in a forward direction similar to the forward edge of the fingernail. The inner edge of the blade thus has a concave contour 9 which permits it to fit into the recess formed by the nail and the quick of the surgeon's finger. The shape of the crescentic blade 5 and the proportions of its outer edge portion 8 and its inner concave edge portion 9 are such that when the ring portion 7 is slipped onto the distal phalanx of the surgeon's finger so that the concave portion 9 fits into the recess between the quick of the finger and the fingernail 10, as shown in Fig. 2, the blade extends from the quick to a position substantially beyond the edge of the fingernail but advantageously conforming substantially to the transverse contour of the finger tip 11.

In lieu of a crescentic cutting edge roughly paralleling the fingernail, the outer edge portion 8 may be extended around the side of the finger as shown in Fig. 5 or may be provided with a knife blade 8a secured to the outer edge portion 8 in a plane perpendicular thereto. On the other hand, the outer edge portion 8 may have secured thereto, and projecting outwardly therebeyond, any other surgical instrument device such as a needle or the like the manipulation of which is enhanced by sensitivity of control.

The surgical instrument of my invention is characterized by the remarkable degree of sensitivity of control which it makes possible. This sensitivity is attributable primarily to the inner edge portion of the crescentic blade 5 which fits under the fingernail, the inner edge 9 of the blade thus pressing against the quick of the finger which is notoriously sensitive to any pressure tending to separate the quick from the nail. The concave contour of the inner edge of the crescentic blade produces this separation whenever the slightest pressure is applied against the blade edge 8. Furthermore, in the embodiment of my invention as a knife, the sensitivity of cutting control is enhanced by the position of the cutting edge 8 forward of the fingernail but below it and more nearly flush with the extremity of the finger which is used for palpation. Thus, the cutting edge 8 is positioned in close proximity to the sensitive tip of the finger so that palpation may be used as an accurate guide for the movement and use of the cutting edge of the blade.

The maximum in sensitivity of cutting control is obtained when the crescentic blade 5 and the finger-ring portion 7 are custom-fitted to distal phalanx of the surgeon's finger. The proper contour and length of the outer cutting edge 8 can be readily achieved for this purpose, although the fitting of the inner edge portion 9 for insertion under the surgeon's nail generally requires individual fitting. The fitting of the ring portion 7 is also important but is relatively simple. However, the simplicity of this latter fitting is made possible by the shape of the ring portion 7. That is, the inner diameter of the forward edge 12 of the ring portion 7 is advantageously significantly smaller with respect to the inner diameter of the rearward edge 13 of the ring portion than that called for to conform to the natural taper of

the distal phalanx 14. Consequently, the degree of taper of the interior of the ring portion 7 is greater than the degree of taper of the distal phalanx 14. Consequently, the finger flesh is tightly compressed by the forward edge 12 of the ring portion as shown in Fig. 2, with the result that the bulging flesh 15 in front of the forward edge 12 holds the ring portion securely in position. In the interest of complete safety, however, the finger-ring portion 7 is advantageously provided with an opening 16 through which a safety wire or suture 17 may be threaded to guard against accidental dislocation of the instrument during use.

A readily adjustable finger-ring portion can be provided in the form of the resiliently flexible structures shown particularly in Figs. 3 and 4. In both of these modifications of my novel surgical instrument, the crescentic blade 5 is the same as that shown in Figs. 1 and 2, but the yoke-shaped supporting frame 6 is advantageously formed of a piece of resilient wire 6*a* in lieu of the cast shape shown in Figs. 1 and 2. In Fig. 3, the finger-ring portion comprises a single casting in the form of a plate-like top portion 7*a* and a double wire band portion 7*b*. In Fig. 4, a similar wire yoke 6*a* is used, but the finger-ring portion is composed of a V-shaped wire top portion 7*c* and a double wire band portion 7*d*. In both of the structures shown in Figs. 3 and 4, the flexibility of the wire-like components makes it much simpler to bend and adjust these portions to fit the surgeon's finger than is the case with the heavier and rigid structure shown in Figs. 1 and 2. By constructing these wire portions of a metal such as stainless steel, they will not only be flexible so as to facilitate adjustability but they will be resilient so as to insure a firm and secure fit on the surgeon's finger. Moreover, each wire band portion, if it engages the finger sufficiently tightly, will compress the flesh in the same manner as the forward edge 12 of the device shown in Fig. 2 but at two spaced positions along the finger instead of at one position as in Fig. 2.

It will be appreciated, accordingly, that the surgical instrument of my invention makes possible the ultimate in functional sensitivity and control for surgical operations and particularly for those operations in which palpation is the sole or principal guide for the cutting action.

I claim:

1. A surgical instrument comprising a substantially crescentic blade the inner edge of which is provided with a substantially concave contour adapted to fit into the recess formed by the nail and the quick of a finger, a supporting frame the ends of which engage and support the crescentic blade, and a finger-ring portion secured to the blade-supporting frame and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail, the projecting portion of the crescentic blade being provided with a surgical implement.

2. A surgical instrument comprising a substantially crescentic blade the inner edge of which is provided with a substantially concave contour adapted to fit into the recess formed by the nail and the quick of a finger, a supporting frame the ends of which engage and support the crescentic blade, and a finger-ring portion secured to the blade-supporting frame and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail, the forward edge of the ring portion having an inner diameter significantly smaller with respect to the inner diameter of the rearward edge of the ring portion than that called for to conform to the natural taper of the distal phalanx.

3. A surgical knife capable of providing cutting action simultaneous with digital palpation and comprising a substantially crescentic blade the outer edge of which is sharpened to provide a cutting edge and the inner edge of which is provided with a substantially concave contour adapted to fit into the recess formed by the nail and the quick of a finger, a supporting frame the ends of which engage and support the crescentic blade, and a finger-ring portion secured to the blade-supporting frame and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail.

4. A surgical knife capable of providing cutting action simultaneous with digital palpation and comprising a substantially crescentic blade the outer edge of which is sharpened to provide a cutting edge and the inner edge of which is provided with a substantially concave contour adapted to fit into the recess formed by the nail and the quick of a finger, a supporting frame the ends of which engage and support the crescentic blade, and a finger-ring portion secured to the blade-supporting frame and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail, the forward edge of the ring portion having an inner diameter significantly smaller with respect to the inner diameter of the rearward edge of the ring portion than that called for to conform to the natural taper of the distal phalanx.

5. A surgical knife capable of providing cutting action simultaneous with digital palpation and comprising a substantially crescentic blade the outer edge of which is sharpened to provide a cutting edge and the inner edge of which is provided with a substantially concave contour adapted to fit into the recess formed by the nail and the quick of a finger, a yoke-shaped frame the ends of which engage and support the crescentic blade, and a finger-ring portion secured to the yoke and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail.

6. A surgical knife capable of providing cutting action simultaneous with digital palpation and comprising a substantially crescentic blade the outer edge of which is sharpened to provide a cutting edge and the inner edge of which is provided with a substantially concave contour adapted to fit into the recss formed by the nail and the quick of a finger, a supporting frame the ends of which engage and support the crescentic blade, and a finger-ring portion secured to the blade-supporting frame and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail, the depth of the crescentic blade being such as to extend from the quick to a position substantially coterminous with the tip of the finger and the contour of the cutting edge of the blade conforming to the transverse contour of the tip of the finger.

7. A surgical instrument comprising a substantially crescentic blade the inner edge of which is provided with a substantially concave contour adapted to fit into the recess formed by the nail and the quick of a finger, a supporting frame the ends of which engage and support the crescentic blade, and a finger-ring portion secured to the blade-supporting frame and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail, the finger-ring portion being resiliently flexible so as to insure a secure fit of the knife to the finger.

8. A surgical knife capable of providing cutting action simultaneous with digital palpation and comprising a substantially crescentic blade the outer edge of which is sharpened to provide a cutting edge and the inner edge of which is provided with a substantially concave contour adapted to fit into the recess formed by the nail and the quick of a finger, a supporting frame the ends of which engage and support the crescentic blade, and a finger-ring portion secured to the blade-supporting frame and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position

beneath and projecting beyond the fingernail, the finger-ring portion being resiliently flexible so as to insure a secure fit of the knife to the finger.

9. A surgical knife capable of providing cutting action simultaneous with digital palpation and comprising a substantially crescentic blade the outer edge of which is sharpened to provide a cutting edge and the inner edge of which is provided with a substantially concave contour adapted to fit into the recess formed by the nail and the quick of a finger, a yoke-shaped frame the ends of which engage and support the crescentic blade, and a finger-ring portion secured to the yoke and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail, the depth of the crescentic blade being such as to extend from the quick to a position substantially coterminous with the tip of the finger and the contour of the cutting edge of the blade conforming to the transverse contour of the tip of the finger, the finger-ring portion being resiliently flexible so as to insure a secure fit of the knife to the finger.

10. A surgical instrument comprising a substantially

crescentic blade the inner edge of which is provided with a substantially concave contour adapted to fit into the recess formed by the nail and the quick of a finger, a supporting frame the ends of which engage and support the crescentic blade, a finger-ring portion secured to the blade-supporting frame and adapted to engage the distal phalanx of the finger so as to hold the blade in operative position beneath and projecting beyond the fingernail, and a surgical implement secured to the portion of the blade which projects beyond the fingernail.

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