

- [54] **SURGICAL TOOL AND METHOD OF PROVIDING A SURGICAL OPENING**
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- [73] Assignee: **Tecna Corporation,** Emeryville, Calif.
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- [52] **U.S. Cl.** **128/305**
- [51] **Int. Cl.** **A61b 17/32**
- [58] **Field of Search**..... **128/305; 30/178, 30/179, 182, 301**

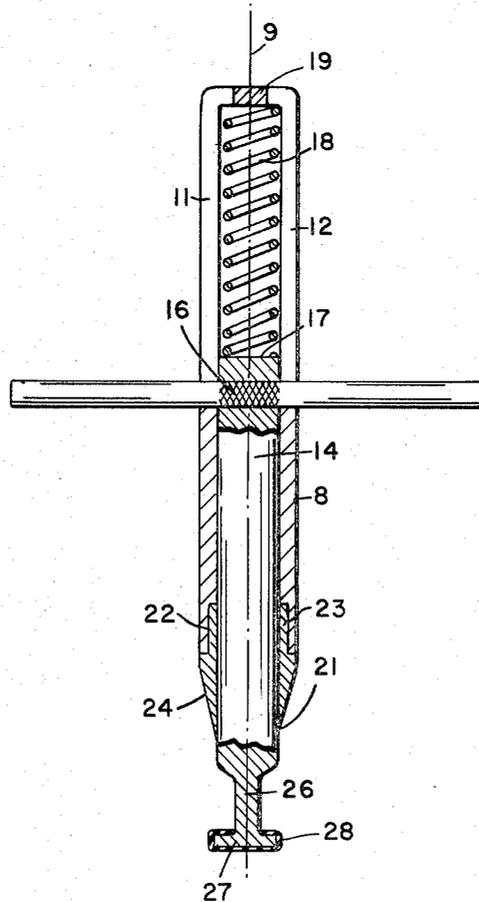
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[57] **ABSTRACT**
 A surgical tool especially for providing a circular opening in a wall such as that of a blood vessel has an outer, circular-cylindrical casing having a longitudinal axis and having a circular knife edge at one end. A plunger is axially movable within the casing by a rod extending transversely through the plunger and through longitudinal slots in the casing. A spring, abutting the end of the plunger and an end of the casing, urges the plunger toward the one end of the casing. A reduced stem at an adjacent end of the plunger carries a circular disk anvil of greater diameter than the knife edge and in the path thereof.

5 Claims, 4 Drawing Figures

- [56] **References Cited**
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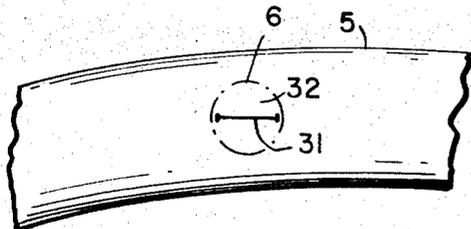


FIG _ 1

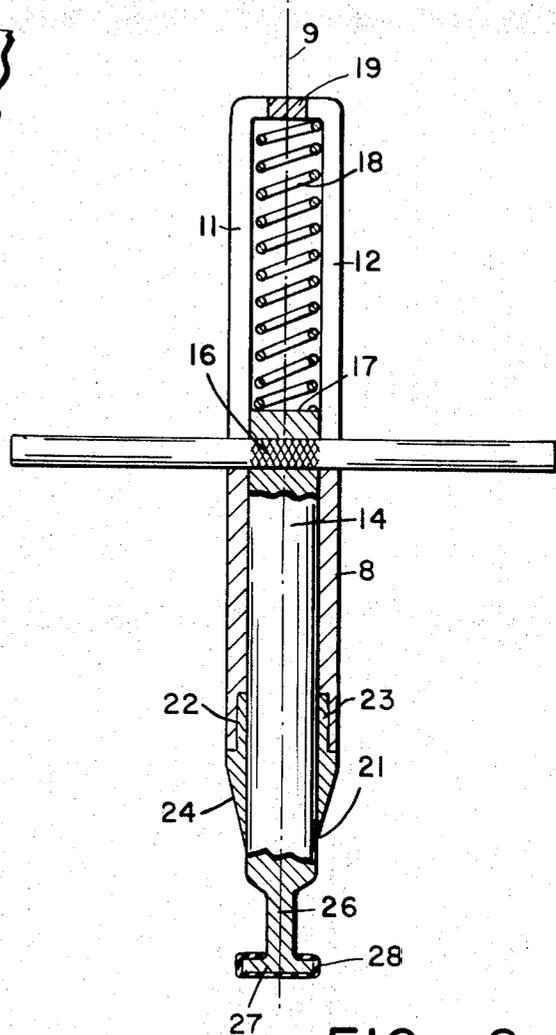


FIG _ 2

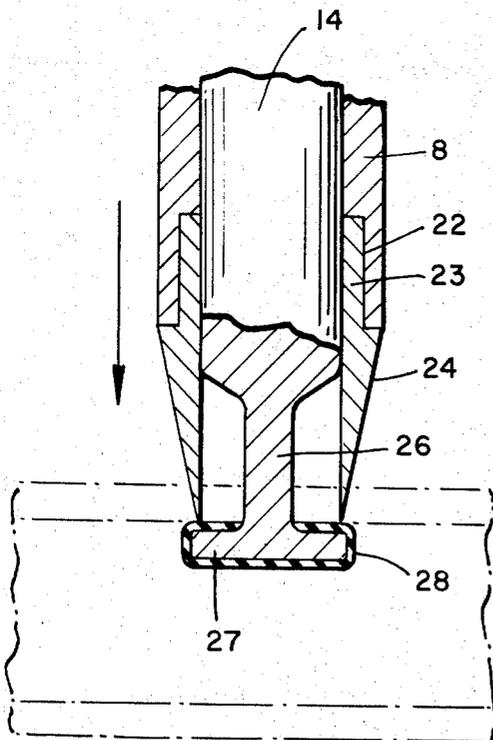


FIG _ 3

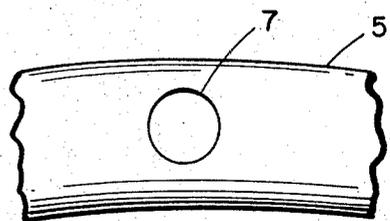


FIG _ 4

SURGICAL TOOL AND METHOD OF PROVIDING A SURGICAL OPENING

A circular opening is provided in a vessel wall by first making a straight incision from the outside through the wall and somewhat shorter than the diameter of the opening, then inserting an anvil of larger diameter than the opening through said incision and into supporting abutment with the inside of the wall and then forcing a circular knife of the diameter of the opening through the wall from the outside and into contact with the anvil and encircling the straight incision.

In many surgical procedures, particularly those involving the area of the heart and various of the coronary arteries and veins especially the aorta or heart wall itself, it is necessary to attach a substitute or supplementary blood vessel to the heart or one of the existing vessels. This is done by providing an opening in the wall of one of the vessels to the margins of which the end of the other vessel is sutured. Obviously, the annular junction must be liquid tight. But there is considerable difficulty in making a certain, leakproof connection since often the opening in the wall of one of the vessels is somewhat irregular or requires a great deal of manipulation and lengthy preparation in order to be made reasonably regular and so afford a proper junction.

It is therefore an object of our invention to provide a surgical tool that can quickly and readily be used during an operation for preparing, in each instance, a completely regular and smooth-margined opening in a walled vessel such as a blood vessel.

Another object of the invention is to provide a surgical tool that is sufficiently simple and inexpensive so that it can be discarded after use at one operation.

Another object of the invention is to provide a surgical tool that can quite readily be handled and sterilized.

An additional object of the invention is to provide a surgical tool that can easily and readily be manipulated even by one hand of the surgeon to provide an appropriate vessel wall opening.

A further object of the invention is in general to provide a useful and improved surgical tool.

A further object of the invention is to afford a method of providing a surgical opening in a walled vessel.

Other objects, together with the foregoing, are attained in the embodiment of the invention and the practice of the method set forth in the accompanying description and generally illustrated in the accompanying drawings, in which:

FIG. 1 is an elevation of a portion of a typical walled vessel illustrating the preparation thereof for the use of the surgical tool and indicating the bounds of the cut to be made therein;

FIG. 2 is a cross-section on an axial, longitudinal plane showing the internal construction of the tool of the invention;

FIG. 3 is an enlarged view similar to FIG. 2 and showing the tool in position at the operating site; and

FIG. 4 is a view similar to FIG. 1 but showing the result of the use of the tool.

As an example, it can be assumed that there is to be attached to a blood vessel 5 of substantial size and typically in the region of the heart, or even to the heart itself, a connecting vessel disposed at substantially a right angle and having a diameter represented by the broken line circle 6 in FIG. 1. To provide an opening 7 corresponding to the circle 6 there is afforded a tool,

as especially illustrated in FIGS. 2 and 3, including an outer, circular-cylindrical or tubular casing 8 symmetrical about a longitudinally extending, central axis 9. The casing 8 like most of the remaining parts of the structure is of a metal or comparable material which can readily withstand the normal sterilizing techniques yet will be stable for at least a few uses prior to discard.

The casing 8 is pierced between its ends with a pair of longitudinally extending, side slots 11 and 12. Through the slots extends a rod 13 of sufficient length to project a considerable distance on either side of the casing. The rod is pressed into and is firmly lodged in an axially extending, circular-cylindrical plunger 14 designed to reciprocate readily within the casing. The rod has central knurling or roughening 16 in order that it will retain its assembled position.

The plunger 14 is provided with a flat surface 17 at one end against which abuts a coil expansion 18. The other end of the spring abuts a bridge 19 at the outer end of the casing remaining after the circular-cylindrical, closed end tube has been provided with the slots 11 and 12. The effect is that the spring 18 urges the plunger and the rod 13 toward one end of the grooves 11 and 12 at which the casing serves as a stop.

Adjacent its open end the casing 8 is provided with a knife edge 21 of the diameter of the circle 6 and of the eventual opening 7. Preferably, although not necessarily, this edge is of a continuous, circular contour centered on the axis 9. While the casing 8 itself can be directly provided with such edge, it is usually preferred to form the casing 8 with a counter bore 22. Into this is set or pressed the hub 23 of a knife ring 24 usually of a material which can quite readily be hardened and ground to afford an extremely sharp knife edge 21.

To cooperate with the knife edge the plunger 14 is extended and is provided with a reduced stem 26 conveniently integral with the plunger 14. The stem has a relatively small, concentric configuration enlarged to provide a generally circular, disk-like anvil 27. The extent of the knife edge 21 is made whatever predetermined value and contour is selected to produce an opening 7 of the size and shape desired. The anvil 27 is made of a diameter or extent somewhat greater than that of the knife edge 21 so that the anvil is in the path of the knife edge. While reference is made to diameters and to a circular knife edge and a circular anvil, it is possible to make these parts of different configurations such as diamond-shaped or square and the like. It is also possible to serrate or interrupt the knife edge 21 or to provide undulations on the anvil 27. The main concern is to have the knife edge 21 in apposition to or in the path of the anvil 27.

While the knife 21 can engage the base material of the anvil directly, it is usually preferred to dip or otherwise provide the anvil 27 with a superficial coating 28 of a relatively soft, readily sterilizable material such as "Teflon." While the soft surface need be only on that part of the anvil immediately adjacent the edge 21, it is usually easier to coat the whole anvil and that construction is illustrated.

In the use of the surgical tool and in the practice of the method of the invention, the operator first, having a blood vessel 5 available, makes a cut 31 or incision therein from the outside. The cut is of a rectilinear nature, the length of the cut being somewhat less than the diameter of the anvil 27 and especially somewhat less than the predetermined diameter of the circle 6 and of

the knife edge 21. Having made such a cut through the vessel wall, the operator takes the tool and with the bridge 19 against his hand and with his fingers in engagement with the rod 13 on opposite sides of the casing, manipulates the tool so as to insert the anvil 27 through the somewhat smaller cut 31. It is possible to do this since the vessel wall is sufficiently deformable and elastic to pass the somewhat larger anvil 27 from the outside thereof through the cut and into the inside of the vessel or to the other side of the vessel wall.

The operator then pulls the anvil 27 generally to abut against the interior or nether surface of the vessel or wall to serve as a basis for cutting. In so doing he arranges the trace or outline of the anvil 27 substantially as shown by the broken line 6 in FIG. 1, being sure to bracket the ends of the somewhat shorter cut 31. There is some distortion of the cut since it must bulge around the reduced stem 26, but the stem size is made small enough so that there is only inconsequential distortion.

The operator then, in effect, holds the rod 13 and depresses the bridge 19 and the casing 8 with respect thereto by an axial movement which compresses the spring 18. The knife edge 21 is thus moved toward and into contact with the adjacent surface of the anvil 27 and engages and severs the vessel wall in a clean, regular and precisely-sized cut 7, as shown in FIG. 4, to result in a detached disk 32. The operator removes the tool from its site while relaxing the spring 18. He not only removes the tool but also removes with it the severed disk 32 containing the cut 31 embracing the stem 26.

Removal of the tool is easy since the material of the

vessel wall is sufficiently elastic and yielding to permit the anvil to be maneuvered out of its position within the vessel.

There is very quickly and accurately provided an opening 7, as desired, with the detached vessel wall disk 32 trapped and carried away from the site by the tool. The disk is either readily removable if the tool is to be used again or is discarded along with the tool.

What is claimed is:

1. A surgical tool especially for use with a blood vessel comprising a casing having a longitudinal axis, means defining a coaxial knife edge at one end of said casing and having a predetermined diameter, a plunger movable axially within said casing, a stem fixed on said plunger and adapted to project axially beyond said end of said casing, and a coaxial anvil fixed on said stem and having a surface normal to said axis and exposed to said knife edge, said surface being disposed in the longitudinal path of said knife edge, said anvil being a blunt-edge disc having a diameter larger than said predetermined diameter.

2. A device as in claim 1 including means for urging said anvil away from said knife edge.

3. A device as in claim 2 in which said urging means includes a spring within said casing and inter-posed between and abutting against one end of said plunger and an end of said casing.

4. A device as in claim 1 in which said knife edge defining means is a separate, conical piece mounted on said casing at one end thereof.

5. A device as in claim 1 including a soft coating on at least the portion of said anvil facing said knife edge.

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