

Oct. 12, 1954

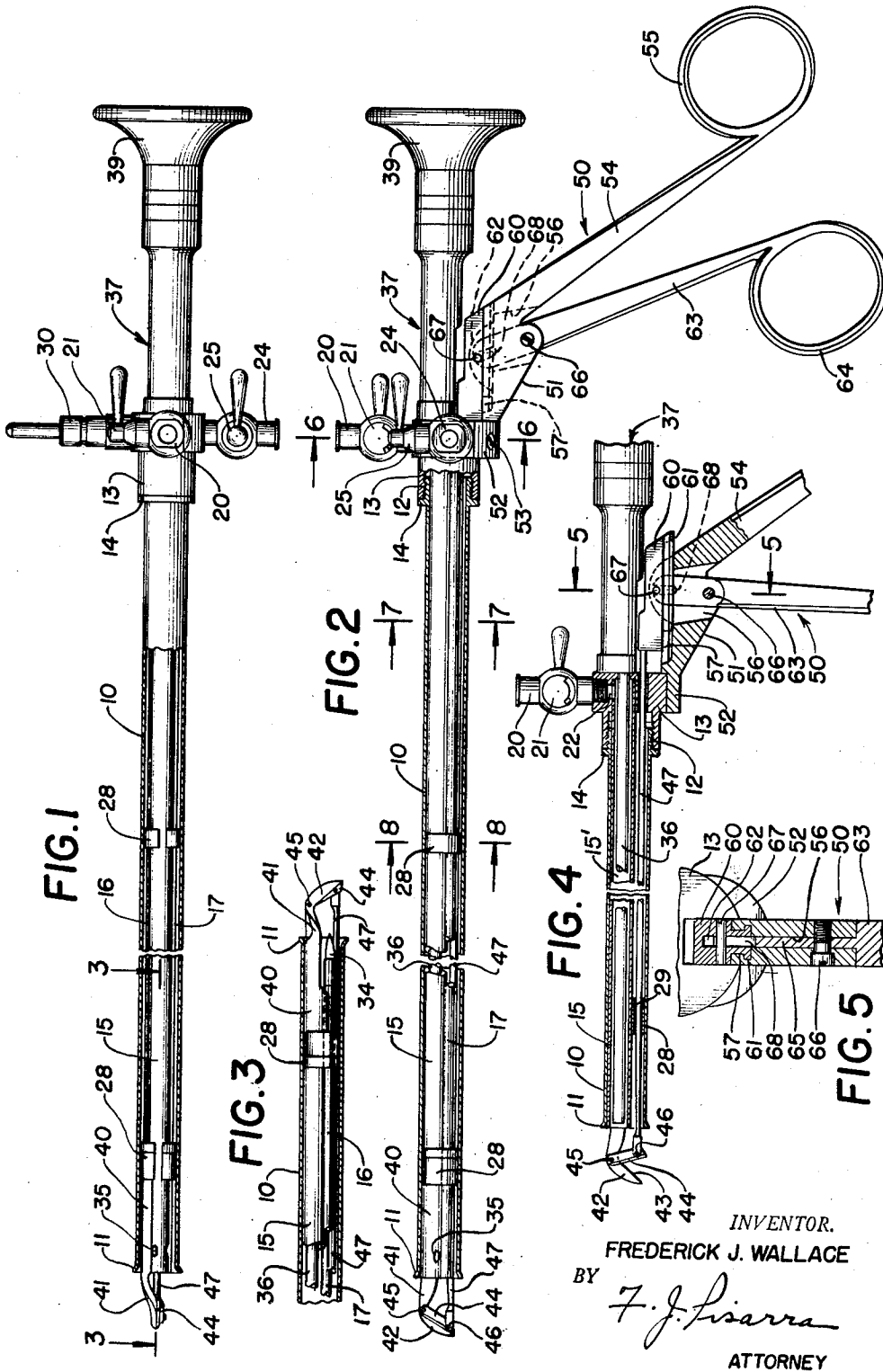
F. J. WALLACE

2,691,370

INSTRUMENT FOR HEART SURGERY

Filed March 27, 1952

2 Sheets-Sheet 1



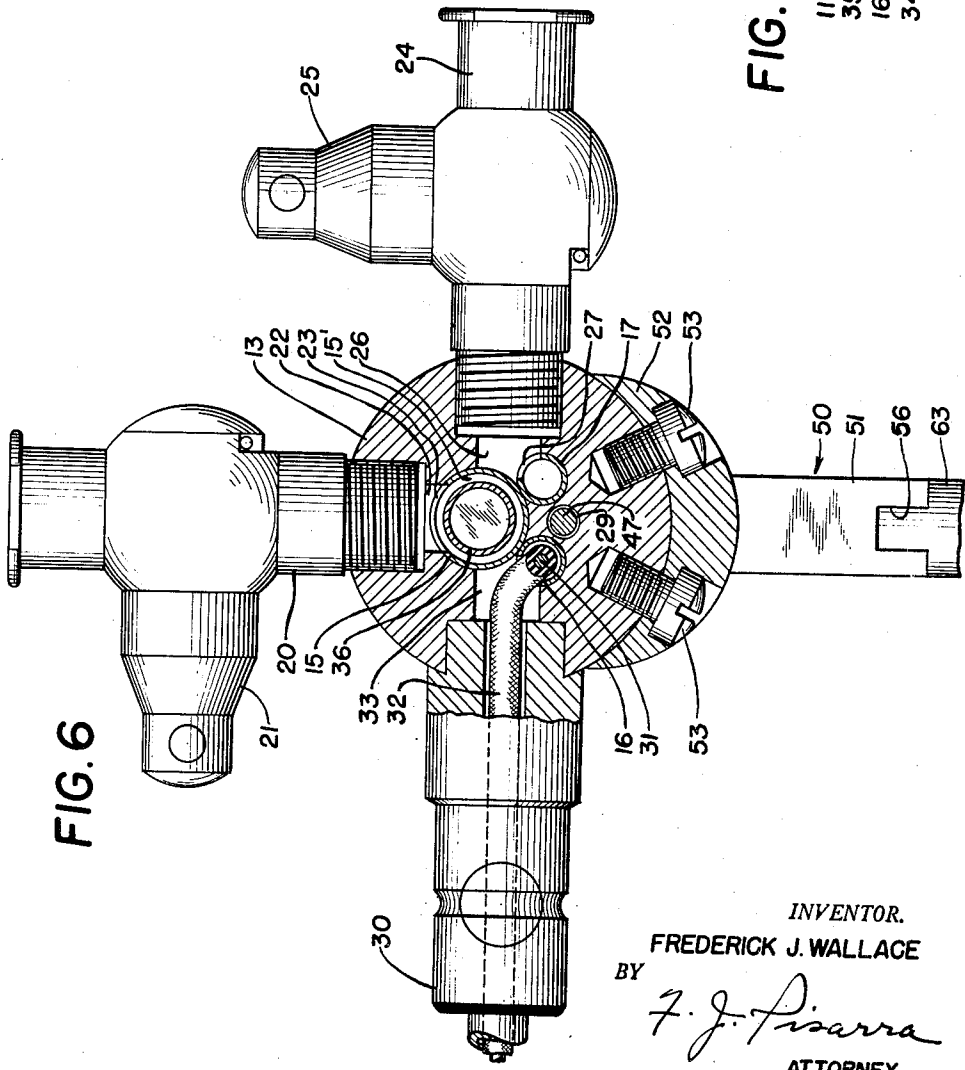
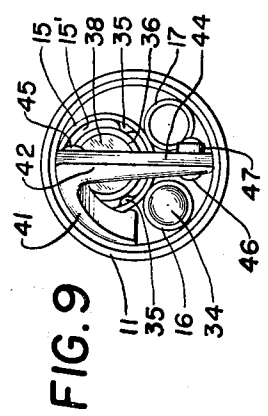
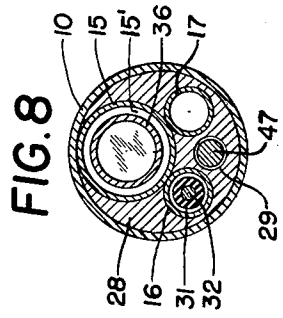
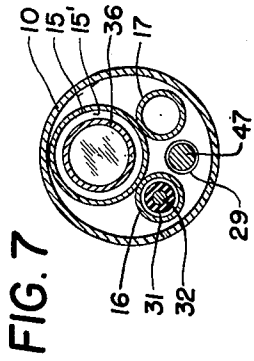
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2 Sheets-Sheet 2



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INSTRUMENT FOR HEART SURGERY

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12 Claims. (Cl. 128-6)

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This invention relates to a surgical instrument and, more particularly, to such an instrument that is adapted to be employed advantageously in operating on the living human heart under conditions of illuminated vision.

Statistics indicate that heart failure is the leading present-day cause of death in this country. One of the principal conditions that contributes to heart failure is stenosis of a heart passage in the region of the mitral, aortic or pulmonary valves. Such stenosis is often a consequence of the thickening of one or another of these valves due to rheumatic fever or other degenerative processes. Heart valves that have thus become thickened, or hardened or calcified for any reason, cease to function normally and, as a result, cause changes in the rate of flow of blood from one chamber of the heart to another with attendant ill effects on the health of an individual.

Several surgical procedures have been attempted with the view of alleviating these conditions. These procedures have contemplated providing an opening through the wall of the heart, inserting a small knife through the opening and slitting the valve under consideration with the aid of the knife. These procedures have been limited in their application and have not proven to be satisfactory for the principal reason that they are necessarily blind procedures, and as a consequence the operating surgeon is unable to view the heart valve that is being operated on and is unable to observe the actual cutting step of the procedure.

The surgical instrument of this invention successfully overcomes the objections experienced in earlier procedures as it permits of the cutting of portions of a heart valve under conditions of illuminated and adequate vision. In this connection, the operating surgeon may, by the use of my instrument, properly view the section of the heart valve to be operated on and simultaneously sever a portion of such valve in a manner as to permit normal functioning of the valve after the operation is completed.

A preferred and recommended surgical instrument constructed in accordance with this invention includes a support that carries a plurality of parallel forwardly extending tubes that comprise a telescope-receiving first tube, a rod-receiving second tube, a lamp-carrier third tube, and a fluid-transmitting fourth tube. A surgical telescope is positioned within the first tube and defines therewith an annular space that communicates with a conduit which is also carried by the

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support. A second conduit carried by the support communicates with the fourth tube. These conduits and the corresponding tubes permit the introduction and withdrawal of suitable liquids into and from selected regions within the heart. The instrument is provided with a scissors type tissue-severing means comprising a stationary blade disposed forwardly of and in spaced relation to the distal end of the first tube and the telescope, and a movable blade pivoted at its opposite ends to the stationary blade and to a rod which is slidable in the second tube. The blades are so arranged as to be viewed through the telescope. The rod is reciprocable through the medium of a means that will be described in detail further along herein, whereby to impart corresponding pivotal movement to the movable blade relative to the stationary blade.

The primary object of the invention is to provide a surgical instrument that is adapted to be used advantageously in internal surgical procedures and especially those concerned with the interior of the human heart.

Another object of the invention is to provide an improved surgical instrument capable of being inserted into a living human heart by way of a previously formed incision and thereupon operated under conditions of illuminated vision to sever heart tissue, such as tissue that forms part of the mitral, aortic or pulmonary valves.

A further object of the invention is to provide an instrument of the character indicated that is simple and compact in construction, reasonable in manufacturing and upkeep costs, and capable of performing its intended functions in a satisfactory manner.

The foregoing objects, as well as additional objects, and the advantages obtainable by the use of the instrument of this invention will be readily apparent to persons skilled in the art upon reference to the following detailed description taken in conjunction with the annexed drawings which respectively describe and illustrate a preferred embodiment of the invention.

In the drawings:

Figure 1 is a top plan view, partly in longitudinal cross section, of an instrument constructed in accordance with this invention;

Figure 2 is a side elevational view of the instrument shown in Figure 1, partly in longitudinal cross section, certain of the parts being broken away for better illustration;

Figure 3 is a fragmentary view taken along line 3-3 of Figure 1;

Figure 4 is a view corresponding to Figure 2, a

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number of the parts being omitted, other parts being shown in another relative position, and certain parts being shown in cross section;

Figure 5 is an enlarged, cross-sectional view taken along line 5—5 of Figure 4;

Figure 6 is a view in enlargement taken along line 6—6 in Figure 2;

Figure 7 is a view in enlargement taken along line 7—7 of Figure 2;

Figure 8 is a view in enlargement taken along line 8—8 of Figure 2; and

Figure 9 is an enlarged view taken from the left of Figure 2.

Referring now to the drawings wherein like reference numerals denote corresponding parts throughout the several views, the surgical instrument illustrated therein includes a tubular sheath 10 that is slightly flared at its forward end 11 and that is externally threaded at its rearward end 12 for engagement with corresponding threads in a tubular support member 13. Sheath 10 is provided with a circular flange 14 immediately adjacent its threaded end portion 12 for abutting the forward end of support member 13. Secured to and forming a fluid-tight fit with support member 13 is a cluster of parallel forwardly projecting tubes, namely, a combined fluid-transmitting and telescope-receiving tube 15, a light-carrier tube 16 and a fluid-transmitting tube 17.

Support member 13 carries a first conduit 20 having a petcock 21. This conduit is adapted to be connected to a source of fluid supply (not shown) and transmit such fluid into tube 15 by way of a passage 22 in member 13 (Figure 6) and an opening 23 in the wall of tube 15. Member 13 also carries a second conduit 24 having a petcock 25. Conduit 24 is adapted to be connected to a partial vacuum (not shown) for effecting withdrawal of fluid from tube 17 by way of a passage 26 in the tubular member and an opening 27 in the wall of tube 17.

Tubes 15, 16 and 17 are maintained in the illustrated relative position with the aid of holding elements 28 (Figure 8), each of which has a rod passage 29. These passages 29 are aligned and parallel to the axes of tubes 15, 16 and 17. Holders 28 may be considered as tubes defining passages 29. As shown in Figures 7 and 8, tubes or holders 28 are positioned below tube 15, while tubes 16 and 17 are located to opposite sides of a plane common to the axes of tubes 15 and 28. Further, the axes of tubes 16 and 17 lie intermediate the axes of tubes 15 and 28. This results in a compact tube assemblage that contributes materially to the utility of the instrument as a whole and to the benefits obtainable by the use thereof in practice.

An electric contact terminal 30 is adapted to be connected to a suitable source of electric current supply. An electric conductor, comprising a wire 31 imbedded in a suitable insulating sheath 32, is secured at one end to terminal 30, extends through a passage 33 in tubular member 13, and then extends through the interior of light-carrier tube 16. Wire 31 makes electrical contact with a miniature lamp 34 that is carried at the forward end of tube 16 (Figures 3 and 9).

As is best shown in Figures 1, 2 and 9, telescope tube 15 is provided with a plurality of angularly spaced internal projections or teats 35 slightly rearward of its forward end. The stem 36 of a surgical telescope 37 is adapted to be inserted in tube 15 by way of a through passage in member 13. The telescope stem is supported at its for-

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ward end by teats 35 and at its rearward end by member 13 in a manner that it forms in annular space 15' with the interior of tube 15. The telescope has a suitable lens system, including an objective lens 38 (Figure 9), and an eyepiece 39. The lens system is such as to provide an adequate forward field of vision, the necessary illumination being supplied by lamp 34 when the instrument is in active use.

The instrument is provided with a scissors type tissue-severing means that will now be described. In this connection, there is secured to the distal end of tube 15 a member 40 having a bent forward extension 41 that terminates in a stationary or fixed blade 42. This blade has a cutting edge 43 that is inclined in a downward and forward direction as best shown in Figure 4. A movable blade 44 is pivoted at its upper end to the stationary blade as indicated at 45. The movable blade is pivoted at its lower end, as indicated at 46, to the forward end of an actuating rod 47 that is slidable in passages 29. Blades 42 and 44 are so constructed and arranged with respect to other parts as to lie in the field of vision of telescope 37.

The instrument is provided with a forceps type control unit 50 for imparting reciprocation to rod 47 and corresponding pivotal movement of movable blade 44 with respect to the stationary blade 42. The control unit includes a support body 51 having an integral saddle 52. As is best shown in Figures 2, 4 and 6, member 13 rests on saddle 52 and is secured thereto by a pair of screws 53. Also integral with body 51 is a handle 54 having a thumb-receiving loop 55. Body 51 is provided with a vertical through slot 56 and a horizontal groove 57, best shown in Figures 4 and 5. A slide block 58 is connected to the rearward end of rod 47 and has an integral depending rail 61 that rides in groove 57. The slide block is slotted as indicated at 62.

The control unit also includes a movable handle 63 having a finger-receiving loop 64 and an upper extension 65 that registers with slot 56 in support body 51 and projects into slot 62 in slide block 60. Handle 63 is pivotally connected to support body 51 by a pivot screw 66. A pin 67 carried by slide block 60 extends across slot 62 and registers with a slot 68 in the upper end portion of extension 65. It will be apparent from an examination of Figures 2 and 4 that pivotal movement of handle 63 in one direction effects corresponding movement of block 60 and rod 47 and pivotal movement of movable blade 44 with respect to stationary blade 42.

For the purpose of briefly outlining the mode of operation of the above described embodiment of the invention, it is assumed that the instrument is to be used to operate on a living human heart for the purpose of severing portions of the tissue of the mitral valve. The heart is exposed and a purse string suture is placed in the heart. An incision is made in the left ventricle and the forward end portion of the instrument is inserted through the incision. The suture is then drawn around sheath 10 to minimize loss of blood. The instrument is next advanced in the heart to the mitral valve. The parts of the instrument are in the relative position shown in Figure 2 and lamp 34 is energized during the time the instrument is inserted through the incision and advanced into the heart. An isotonic saline solution from a suitable source and under appropriate pressure is then forced into the heart by way of conduit 20, passage 22, opening 23 and an-

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nular space 15'. The solution is thus discharged from the instrument in the region adjacent to objective lens 38 of the telescope and moves the blood in the immediate vicinity of the objective lens out of the way, thereby permitting clear visualization of the parts of the heart directly forward of the objective lens. Simultaneously with the foregoing, a vacuum is applied to conduit 24. With petcock 25 open, the vacuum withdraws from the heart, by way of tube 47, opening 27, passage 26 and conduit 24, an amount of the solution, or a mixture of the solution and blood, equal to the amount introduced into the heart, whereby to maintain a proper balance. Selected portions of the mitral valve are then severed under conditions of illuminated vision by operating handle 63 of the control unit and correspondingly actuating movable blade 44 with respect to stationary blade 42. Upon completion of the tissue-cutting operation, the instrument is withdrawn from the heart and necessary steps are taken to prevent loss of blood through the previously formed incision.

When the instrument is used to operate on the aortic valve, it is inserted into the heart by way of the carotid artery and the procedure followed is similar to that outlined above with respect to operating on the mitral valve.

From the foregoing, it is believed that the construction, operation and advantages of my present invention will be readily comprehended by persons skilled in the art. It is to be clearly understood, however, that various changes in the apparatus set forth may be made without departing from the scope of the invention, it being intended that all matter contained in the description or shown in the drawings shall be interpreted as illustrative only and not in a limiting sense.

I claim:

1. In a surgical instrument of the character described, a support, a tube secured to and extending forwardly of the support, tissue-severing means comprising a stationary blade disposed forwardly of and in spaced relation to the forward end of the tube and a movable blade pivoted at one end to the stationary blade, said blades being adapted to be viewed through a telescope upon insertion thereof in the tube, a rod pivotally connected at one end to the other end of the movable blade, and means carried by the support and connected to the other end of the rod for imparting reciprocation to the rod and corresponding pivotal movement to the movable blade with respect to the stationary blade.

2. In a surgical instrument of the character described, a support, a tube secured to and extending forwardly of the support, a member secured to and projecting beyond the forward end of the tube, tissue-severing means comprising a stationary blade affixed to the member and disposed forwardly of and in spaced relation to the forward end of the tube and a movable blade pivoted at one end to the stationary blade, said blades being adapted to be viewed through a telescope upon insertion thereof in the tube, a rod reciprocable along a path substantially parallel to the axis of the tube, said rod being pivotally connected at its forward end to the other end of the movable blade, and means carried by the support and connected to the rear end of the rod for imparting reciprocation to the rod and corresponding pivotal movement to the movable blade with respect to the stationary blade.

3. In a surgical instrument of the character

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described, a support, a tube secured to and extending forwardly of the support, tissue-severing means comprising a stationary blade disposed forwardly of and in spaced relation to the forward end of the tube and a movable blade pivoted at one end to the stationary blade, said blades being adapted to be viewed through a telescope upon insertion thereof in the tube, a rod reciprocable along a path substantially parallel to the axis of the tube, said rod being pivotally connected at its forward end to the other end of the movable blade, and means carried by the support and connected to the rear end of the rod for imparting reciprocation to the rod and corresponding pivotal movement to the movable blade with respect to the stationary blade, said last mentioned means comprising a block mounted on and slidable with respect to the support, a handle pivotally connected to the support, and means for translating pivotal movement of the handle into sliding movement of the block.

4. A surgical instrument in accordance with claim 3, wherein the last mentioned means comprises a pin carried by the block and registering with a slot in the handle.

5. In a surgical instrument of the character described, a support, a plurality of parallel tubes secured to and extending forwardly of the support and comprising a first tube for receiving a telescope, a second tube for carrying a lamp, and a third tube for transmitting a fluid, tissue-severing means comprising a stationary blade disposed forwardly of and in spaced relation to the forward end of the first tube and a movable blade pivoted at one end of the stationary blade, said blades being adapted to be viewed through a telescope upon insertion thereof in the first tube, a rod reciprocable along a path parallel to the axes of said tubes, said rod being pivotally connected at its forward end to the other end of the movable blade, and means carried by the support and connected to the other end of the rod for imparting reciprocation to the rod and corresponding pivotal movement to the movable blade with respect to the stationary blade.

6. In a surgical instrument of the character described, a support, a plurality of parallel tubes secured to and extending forwardly of the support and comprising a first tube for receiving a telescope, a second tube for carrying a lamp, and a third tube for transmitting a fluid, a conduit carried by the support and communicating with the first tube, a conduit carried by the support and communicating with the third tube, tissue-severing means comprising a stationary blade disposed forwardly of and in spaced relation to the forward end of the first tube and a movable blade pivoted at one end to the stationary blade, said blades being adapted to be viewed through a telescope upon insertion thereof in the first tube, a rod reciprocable along a path parallel to the axes of said tubes, said rod being pivotally connected at its forward end to the other end of the movable blade, and means carried by the support and connected to the other end of the rod for imparting reciprocation to the rod and corresponding pivotal movement to the movable blade with respect to the stationary blade.

7. In a surgical instrument of the character described, a support, a plurality of parallel tubes secured to and extending forwardly of the support and comprising a first tube for receiving a telescope, a second tube for receiving a rod, a third tube for carrying a lamp, and a fourth

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tube for transmitting a fluid, the axes of the third and fourth tubes being disposed to opposite sides of a plane common to the axes of the first and second tubes and intermediate the axes of the first and second tubes, tissue-severing means comprising a stationary blade disposed forwardly of and in spaced relation to the forward end of the first tube and a movable blade pivoted at one end of the stationary blade, said blades being adapted to be viewed through a telescope upon insertion thereof in the first tube, a rod reciprocable in the second tube and pivotally connected at its forward end to the other end of the movable blade, and means carried by the support and connected to the other end of the rod for imparting reciprocation to the rod and corresponding pivotal movement to the movable blade with respect to the stationary blade.

8. In a surgical instrument of the character described, a support, a plurality of parallel tubes secured to and extending forwardly of the support and comprising a first tube for receiving a telescope, a second tube for receiving a rod, a third tube for carrying a lamp, and a fourth tube for transmitting a fluid, the axes of the third and fourth tubes being disposed to opposite sides of a plane common to the axes of the first and second tubes and intermediate the axes of the first and second tubes, a conduit carried by the support and communicating with the first tube, a conduit carried by the support and communicating with the fourth tube, tissue-severing means comprising a stationary blade disposed forwardly of and in spaced relation to the forward end of the first tube and a movable blade pivoted at one end of the stationary blade, said blades being adapted to be viewed through a telescope upon insertion thereof in the first tube, a rod reciprocable in the second tube and pivotally connected at its forward end to the other end of the movable blade, and means carried by the support and connected to the other end of the rod for imparting reciprocation to the rod and corresponding pivotal movement to the movable blade with respect to the stationary blade.

9. In a surgical instrument of the character described, a support, a plurality of parallel tubes secured to and extending forwardly of the sup-

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port and comprising a first tube for receiving a telescope, a second tube for receiving a rod, a third tube for carrying a lamp, and a fourth tube for transmitting a fluid, a telescope in the first tube and defining an annular space with the interior thereof, a conduit carried by the support and communicating with said annular space, a rod reciprocable in the second tube, a lamp secured to the forward end of the third tube, a conduit carried by the support and communicating with the fourth tube, tissue-severing means comprising a stationary blade disposed forwardly of and in spaced relation to the forward end of the first tube and a movable blade pivoted at its opposite ends to the stationary blade and the rod, said blades being adapted to be viewed through the telescope, and means carried by the support and connected to the other end of the rod for imparting reciprocation to the rod and corresponding pivotal movement to the movable blade with respect to the stationary blade.

10. A surgical instrument in accordance with claim 9, wherein the axes of the third and fourth tubes are disposed to opposite sides of a plane common to the axes of the first and second tubes and lie intermediate the axes of the first and second tubes.

11. A surgical instrument in accordance with claim 9, wherein said last mentioned means comprises a block mounted on and slidable with respect to the support, a handle pivotally connected to the support, and means for translating pivotal movement of the handle into sliding movement of the block.

12. A surgical instrument in accordance with claim 11, wherein the last mentioned means comprises a pin carried by the block and registering with a slot in the handle.

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