

[54] **FORCEPS**

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Related U.S. Application Data

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[30] **Foreign Application Priority Data**

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Dec. 5, 1970 Japan..... 45/107834

[52] U.S. Cl..... **128/320, 128/306, 128/309, 128/356**

[51] Int. Cl..... **A01b 1/06, A01b 17/00, A01b 1/72**

[58] Field of Search **128/306, 309, 320, 356**

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Primary Examiner—Aldrich F. Medbery

[57] **ABSTRACT**

A forceps for use with an endoscope has a first or cutting wire which extends in a loop from the distal end of the flexible endoscope tube, whereas the two proximal ends may be shifted in the tube by means of a control mechanism on the proximal tube end so as to expand and contract the loop. A second wire has a distal end pivotally attached to the loop, while its main portion passes through the endoscope tube to a control device at the proximal end of the tube which permits the second wire to be shifted longitudinally in the tube, and thereby to be bulged out from the loop for receiving a polyp or the like, and to be tightened about the severed polyp for safely retracting the severed piece together with the forceps.

4 Claims, 38 Drawing Figures

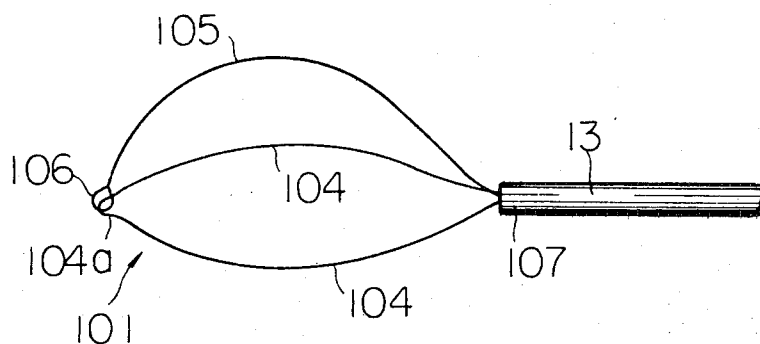


Fig. 1 PRIOR ART

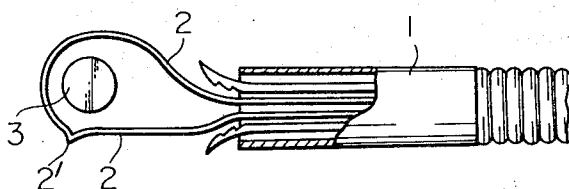


Fig. 2

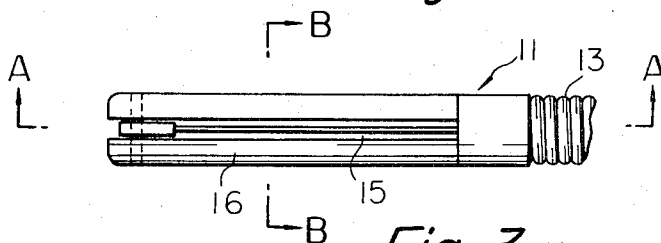


Fig. 3

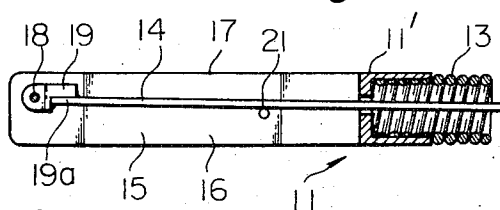


Fig. 4

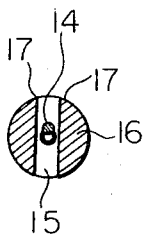


Fig. 5

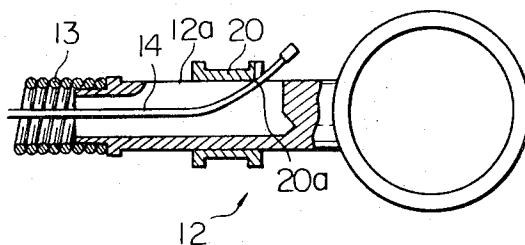


Fig. 6

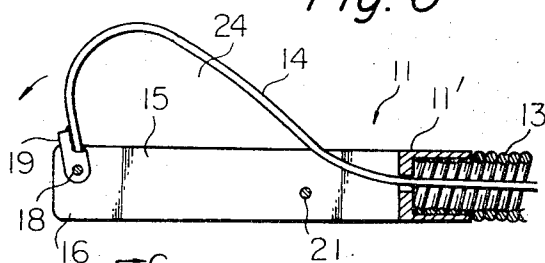


Fig. 7

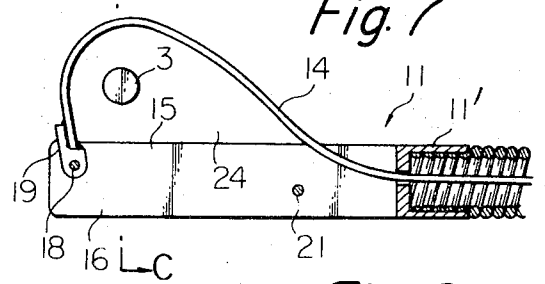


Fig. 8

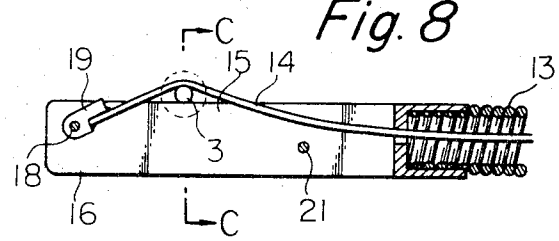


Fig. 9

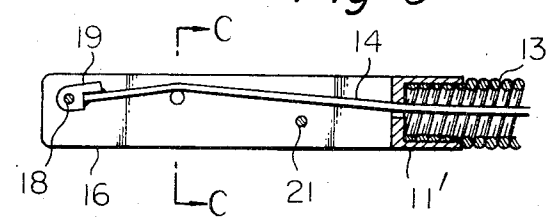


Fig. 10

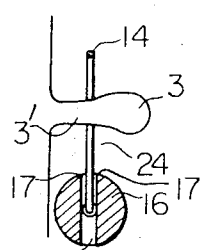


Fig. 11

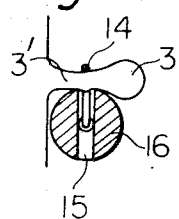


Fig. 12

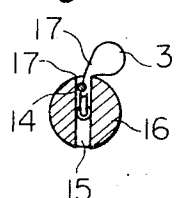


Fig. 13

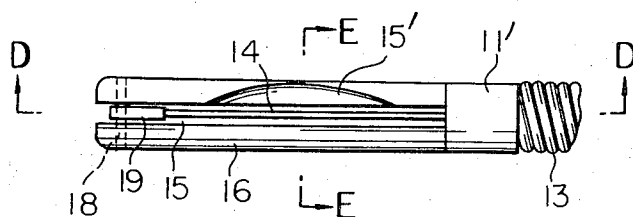


Fig. 14

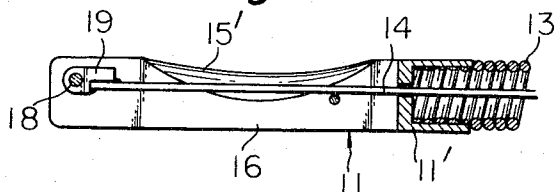


Fig. 16

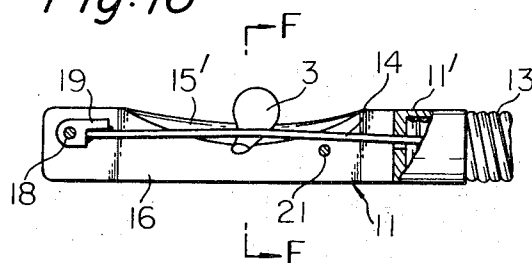


Fig. 15

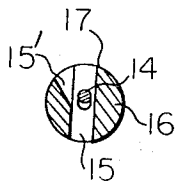


Fig. 17

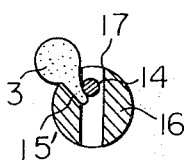


Fig. 18

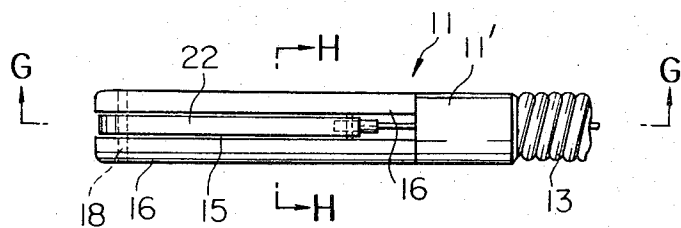


Fig. 19

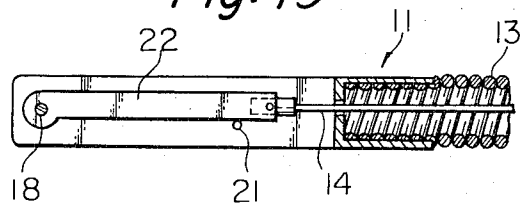


Fig. 20

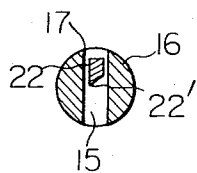


Fig. 21

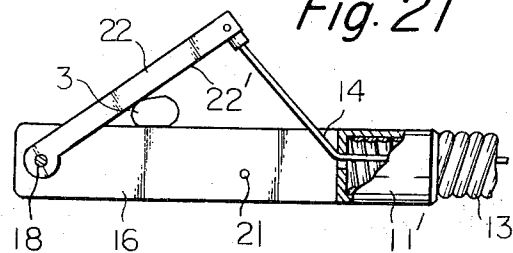


Fig. 22

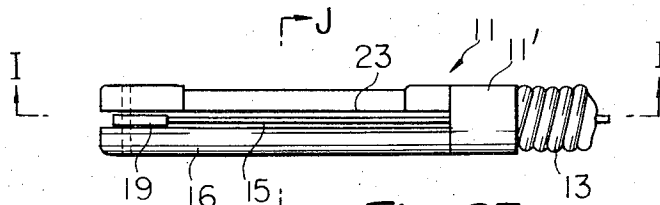


Fig. 23

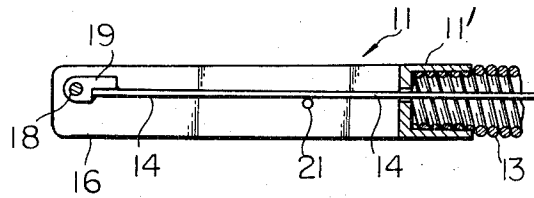


Fig. 24

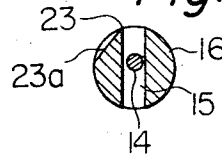


Fig. 25

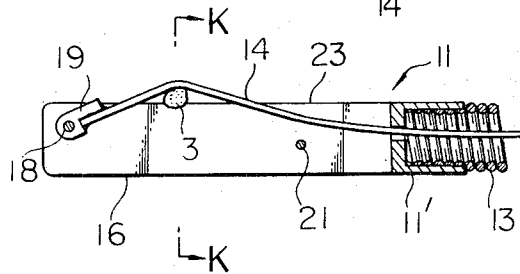


Fig. 26

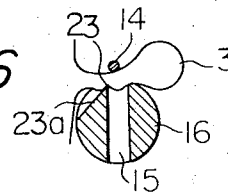


Fig. 27

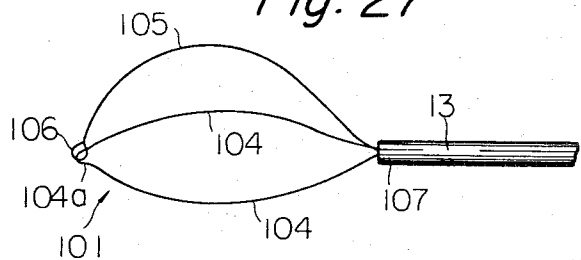


Fig. 28

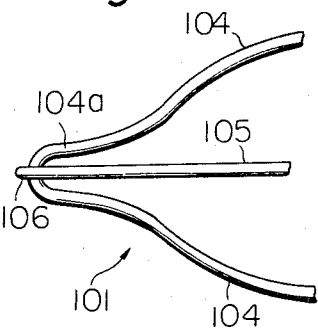


Fig. 29

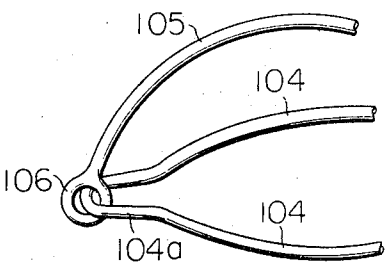


Fig. 30

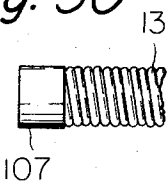


Fig. 31

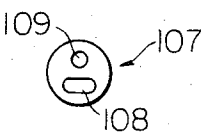


Fig. 32

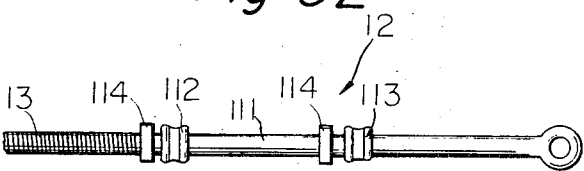


Fig. 33

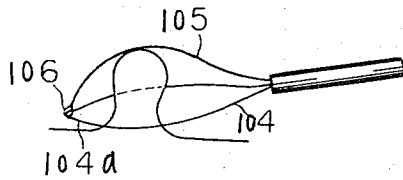


Fig. 34

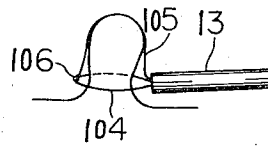


Fig. 35

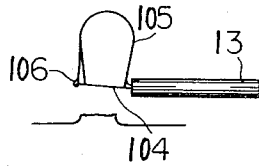


Fig. 36

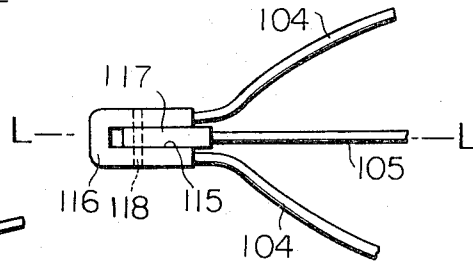


Fig. 38

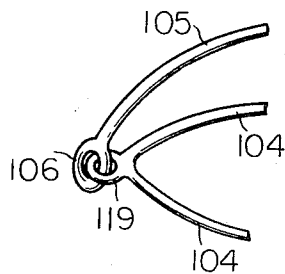
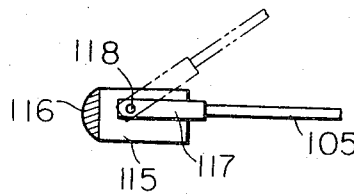


Fig. 37



FORCEPS

This is a division of application Ser. No. 203,633, filed Dec. 1, 1971, now U.S. Pat. No. 3,739,784.

BACKGROUND OF THE INVENTION

The present invention relates to a forceps for use with an endoscope and, more particularly, to forceps capable of positively capturing and severing a mass projecting into a body cavity such as a polyp without destroying the tissue surrounding the polyp and taking out the severed mass.

Heretofore, no effective forceps for use with an endoscope has been developed for severing and taking out a projecting mass such as a polyp growing in the stomach, gullet and the like of a living body.

A prior art forceps of the type described above uses a loop of a wire extending from the distal end portion of a forceps and the projecting mass captured by the loop of the wire is severed by pulling the branches of the wire extending from the loop and extending through the elongated tube of the forceps rearwardly by means of a control means in the proximal control portion of the forceps so as to contract the loop to sever the projecting mass.

In such a forceps, a wire having a relatively large diameter must be used for forming the loop in order to avoid breaking the wire during the repeated use of the forceps. The large diameter interferes with the severing performance of the wire, and the tissue surrounding the projecting mass may be damaged.

Further, it has been very difficult to withdraw the severed mass of the polyp because of the peristaltic movement of organ through which the severed mass must be withdrawn.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a forceps for use with an endoscope capable of positively capturing, severing a projecting mass such as a polyp growing in a body cavity and withdrawing the severed mass without destroying the tissue surrounding the projecting mass to be severed.

The above object is achieved in accordance with the present invention by the provision of a forceps having a proximal control portion, a distal end portion and an elongated flexible tube connecting the distal end portion to the proximal control portion, the forceps being provided with a first wire forming a loop projecting from the distal end portion and having two branches which extend from the loop through the flexible tube, a second wire extending through the flexible tube, its distal end being pivotally connected to the distal end of the loop of the first wire, a first control means provided in the proximal control portion, the proximal ends of the branches of the first wire being connected to the first control means so that the loop is enlarged when the first wire is pushed forwardly while the loop is contracted to sever a projecting mass captured in the loop when the first wire is pulled rearwardly, and a second control means provided in the proximal control portion, the proximal end of the second wire being connected to the second control means in such a manner that the severed mass is captured by the second wire, when the same is pulled rearwardly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an enlarged side view showing the distal end portion of a prior art forceps for use with an endoscope;

FIGS. 2 to 12 are fragmentary views showing the first embodiment of the forceps constructed in accordance with the present invention, FIG. 2 showing a distal end portion in magnified scale, FIG. 3 being the longitudinal sectional view taken along line A—A in FIG. 2, FIG. 4 being the cross-section taken along line B—B in FIG. 2, FIG. 5 showing the proximal control portion of the forceps in elevational section, FIGS. 6 to 9 show various steps of operation of the forceps of FIG. 3, while FIGS. 10 to 12 show the devices of in FIGS. 7 to 9, respectively, in section on the line C—C;

FIGS. 13 to 17 show a modification of the forceps shown in FIGS. 2 to 12, FIG. 13 being a top plan view of the distal end portion, FIG. 14 being a longitudinal sectional view taken along line D—D in FIG. 13, FIG. 15 being a cross-sectional view taken along line E—E in FIG. 13, FIG. 16 being a longitudinal sectional view similar to FIG. 14 but showing a mass capture by the wire while FIG. 17 is a cross-sectional view taken along line F—F in FIG. 16;

FIGS. 18 to 21 show a further modification of the forceps shown in FIGS. 2 to 12, FIG. 18 being a top plan view of the distal end portion, FIG. 19 being a sectional view taken along line G—G in FIG. 18, FIG. 20 being a cross-sectional view taken along line H—H in FIG. 18, while FIG. 21 is a view similar to FIG. 19 but showing a different operating condition of the forceps;

FIGS. 22 to 26 illustrate a still further modification of the forceps shown in FIGS. 2 to 12, FIG. 22 being a top plan view of the distal end portion, FIG. 23 being a sectional view taken along line I—I in FIG. 22, FIG. 24 being a cross-sectional view taken along line J—J in FIG. 22, FIG. 25 being a sectional view similar to FIG. 23 but showing a mass captured between the distal end portion and the wire, while FIG. 26 is a cross-sectional view taken along line K—K in FIG. 25;

FIG. 27 is a schematic perspective view of the distal end portion of the second embodiment of the forceps of the present invention;

FIG. 28 is a fragmentary plan view of the device of FIG. 27;

FIG. 29 is a perspective view of the device of FIG. 28;

FIG. 30 is a fragmentary view on a larger scale of an element of the forceps of FIG. 27;

FIG. 31 is a front view of the element of FIG. 30;

FIGS. 32 is a fragmentary side view showing the proximal control portion of the forceps of FIG. 27;

FIGS. 33 to 35 are views to illustrate sequential operating steps of the forceps of FIG. 27;

FIGS. 36 and 37 show a modification of the device of FIG. 28 in top plan view and side-elevational section respectively; and

FIG. 38 is a fragmentary view of a further modification of the device of FIG. 29.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 showing a prior art forceps, a wire 2 is shown to form a loop extending from the distal end portion 1 of the forceps which is connected to a proximal control portion (not shown) by an elongated flexible tube a portion of which is shown con-

nected to the distal end portion 1. Two branches of the wire 2 extending from the loop extend through the distal end portion 1 and the elongated flexible tube and the proximal ends of the branches are connected to a control means (not shown) provided in the proximal control portion so that the wire 2 is pushed forwardly and pull backwardly by the operation of the control means. In operation, the wire 2 is pushed forwardly after the distal end portion 1 is inserted into a body cavity so that the loop of the wire 2 is enlarged to capture a projecting mass 3 such as a polyp. Then the wire 2 is pulled rearwardly by the operation of the control means, thereby contacting the loop to sever the projecting mass 3. In such a forceps, the wire 2 is turned back upon itself during the operation of the forceps to form a node 2', and tends to be broken at the node 2' as the operation of the forceps is repeated.

FIGS. 2 to 12 show first embodiment of the forceps of the present invention. The forceps shown comprises a distal tubular end portion 11 and a proximal tubular control portion 12 connected to the distal end portion 11 by an elongated flexible tube 13 made of a closely wound helical coil.

The distal end 11 carries a pair of parallel legs 16 extending forwardly of the distal end portion 11 and separated from each other by a slot or elongated recess 15.

The end wall 11' of the distal end portion 11 is formed with a central hole through which a wire 14 shiftably extends into the bore of the tube 13. The forward end of the wire 14 is secured to a connecting piece 19 by means of solder 19a, the connecting piece 19 being in turn rotatably mounted on a pin 18 secured to the legs 16 and extending in the slot 15 laterally thereto. The longitudinal end portion of the wire 14 seen in FIG. 2 is thus limited in its longitudinal movement while being capable of pivotal movement about an axis transverse of the elongation of the slot 15.

The rearward end of the wire 14 extends outwardly of the cylindrical portion of the proximal control portion 12 through an elongated slot 12a formed in the cylindrical portion and secured by solder 20a to an operating or central ring 20 slidably mounted on the cylindrical portion as so that the wire 14 is pushed forwardly or pulled rearwardly by the operation of the operating ring 20.

Thus, when the wire 14 is pushed forwardly, the forward portion of the flexible wire 14 between the connecting piece 19 and the end wall 11' is bent outward of the open side of the slot 15 to form a loop 24 between the wire 14 and the legs 16 in which a projecting mass 3 is easily captured. When the wire 14 is pulled rearwardly, the loop is contracted so that the wire 14 moves into the slot 15 in tensioned state.

At least one leg 16 has a sharp, longitudinal cutting edge 17, and the width of the slot 15 between the wall faces of the legs 16 is made slightly greater than the diameter of the wire 14 permitting the same to easily move into the slot 15 while the close contact of cutting edge 17 with the wire 14 is insured.

Thus, the projecting mass 3 captured in the loop 24 is easily and efficiently severed by the cutting edge 17 when the wire 14 is pulled rearwardly by the operating ring 20 without damage to tissue surrounding the projecting mass 3. The thus severed mass 3 is positively held in the slot 15 by means of the tensioned wire 14.

Pin 21 extending between the legs 16 in the slot 15 serves to prevent the wire 14 from buckling in the di-

rection opposite to that shown in the figures so that the loop of the wire 14 is positively formed at the side where the cutting edge 17 is formed in the leg 16.

In the drawings, the slot 15 is shown as extending from one peripheral surface to the diametrically opposite peripheral surface, however, the slot 15 may be partly closed by a longitudinal bottom surface.

FIGS. 13 to 17 show a modification of the forceps shown in FIG. 2. The forceps of FIGS. 13 to 17 is substantially similar to that shown in FIG. 2 except that a shallow, concave receptacle 15' is formed in the face of one of the legs directed toward the slot 15 and the cutting edge 17 on the other leg 16. The bottom wall of the receptacle is obliquely inclined relative to the slot 15.

The operation of the forceps of FIG. 13 is similar to that of FIG. 2, except that the severed projecting mass 3 is more safely held in the slot 15 by virtue of the provision of the receptacle 15' as shown in FIG. 17.

FIG. 18 to 21 show a further modification of the forceps of FIG. 2. In this embodiment, one end of an arm member 22 having a cutting edge 22' is swingably mounted on the pin 18 and the free end of the more rigid member 22 is pivotally connected to the forward end of the wire 14 so that the member 22 is swung out of the open side of the slot 15 when the wire 14 is pushed forwardly while the member 22 is moved into the slot 15 when the wire 14 is pulled rearwardly. The width of the member 22 is made slightly smaller than the width of the slot 15 for free swinging movement of the member 22 into and out of the slot 15 while the cutting edge 22' of the member shearingly cooperates with the cutting edge 17 of the leg 16 when the member 22 is swung into the slot 15.

The operation of the embodiment of FIG. 18 is substantially similar to that of FIG. 2.

FIGS. 22 to 26 show a further modification of the forceps of FIG. 2.

This embodiment is substantially similar to that of FIG. 2 except that a surface 23a is formed in either one of the outer surfaces of the legs 16 merging with the longitudinal edge thereof so as to form a sharp cutting edge 23 as shown in FIG. 24. Thus, the projecting mass 3 captured between the wire 14 and the legs 16 can be most efficiently severed by the cutting edge 23 cooperating with the tensioned wire 14.

FIGS. 27 to 32 show a forceps of the present invention which comprises a first wire 104 forming a loop extending from the distal end portion 107 with the branches or the portions of the wire 104 extending from the respective ends of the loop through the flexible tube 13 toward the proximal control portion 12. The ends of the branches of the wire 104 pass through an elongated slot (not shown) formed in a cylindrical guide tube 111 and are connected to a first operating or control ring 112 slidably guided on the cylindrical guide tube 111 so that the wire 104 is pushed forwardly to enlarge the loop or pulled rearwardly to contract the loop by the operation of the operating ring 112. The loop of the wire 104 serves to capture the projecting mass and sever the same when the loop is contracted.

A second wire 105 extends through the flexible tube 13, and an eye 106 provided at its distal end is pivotally connected to a bight past 104a of reduced radius of curvature formed at the distal end of the loop of the wire 104 while the rearward end of the wire 105 passes through the elongated slot in the cylindrical guide tube

111 and is connected to a second operating ring 113 slidably guided on the cylindrical guide tube 111 so that, when the operating ring 113 is actuated, the wire 105 is pushed forwardly to form a loop between the eye 106 and the distal end portion 107 or is pulled rearwardly to contract the loop. The second wire 105 serves to positively hold the severed projecting mass. Stationary stop rings 114 are secured to the cylindrical guide tube 111 of the proximal control portion 12 so that the stroke of each of the operating rings 112, 113 is appropriately limited. The stop rings 114 may be adjustable, to suit the conditions under which the operation is to be carried out.

As is shown in FIG. 31, a hole 109 formed in the end wall of the distal end portion 107 is used to slidably pass therethrough the second wire 105 while the elongated hole 108 is used for slidably passing therethrough the branches of the wire 104 extending from the loop of the wire 104.

FIGS. 33 to 35 show the manner how a polyp projecting from an inner wall of a living body is captured and severed by the forceps of FIG. 27.

First, the first and second wires 104, 105 are pushed forwardly by the operation of the operating rings 112, 113 after the distal end portion 107 is inserted together with the endoscope into a body cavity so as to capture the projecting mass within the loop of the wire 104 and in the loop of the wire 105 as shown in FIG. 33 which the projecting mass is observed through the optical system of the endoscope, not shown. Then, the operation ring 112 is manually moved rearwardly to pull the wire 104 so as to contract the loop of the wire 104 thereby severing the projecting mass captured therein. At the same time or after the operation of the first operating ring 112, the second operating ring 113 is moved rearwardly to contract the loop of the wire 105 so that the severed projecting mass is positively held by wire 105 as shown in FIG. 35.

FIGS. 36 and 37 show a modification of the connection of the wire 104 with the wire 105. The two leg ends of a forked connecting piece 116 having a slot 117 are attached to respective distal end portions of the wire 104. A pin 118 is secured to the piece 116 extending laterally of the slot 115 and a pivot piece 117 connected to the distal end of the wire 105 is pivotally mounted on the pin 118 in the slot 115. The operation of the embodiment is similar to that shown in FIG. 28.

FIG. 38 shows a further modification of the connection between the wires 104 and 105. In this embodiment, an eye 119 is provided at the distal end of the

loop formed by the wire 104 and the eye 119 is pivotally engaged with the eye 106 of the wire 105.

We claim:

1. A forceps for use with an endoscope comprising:
 - a. a flexible, elongated tube having a distal end portion and a proximal end portion;
 - b. a first elongated wire having two branch portions and an arcuate loop portion connecting said branch portions, said loop portion projecting from said distal end portion, and said branch portions extending from said loop portion toward said proximal end portion and being movably received in said tube;
 - c. a second wire having a terminal portion pivotally secured to a part of said loop portion remote from said distal end portion in a direction away from said proximal end portion, said second wire being movably received in said tube and extending from said terminal portion toward said proximal end portion;
 - d. first control means on said proximal end portion and operatively connected to said branch portions for shifting the same longitudinally in said tube, whereby the loop defined by said loop portion may be expanded and contracted, and a polyp captured in said loop may be severed by contracting said loop; and
 - e. second control means on said proximal end portion and operatively connected to said second wire for shifting the same longitudinally in said tube to provide a means for securing a polyp severed by said contracting loop portion for subsequent removal with said forceps.
2. A forceps as set forth in claim 1, wherein said part of said loop portion constitutes a bight portion having a smaller radius of curvature than the remainder of said loop portion, said terminal portion being pivotally secured to said bight portion.
3. A forceps as set forth in claim 1, further comprising a forked connecting piece attached to said part of said loop portion and defining a slot, said terminal portion being received in said slot, and a pin member attached to said connecting piece, a portion of said pin member being located in said slot and securing said terminal portion to said connecting piece.
4. A forceps as set forth in claim 1, further comprising a first eye on said part of said loop portion and a second eye on said terminal portion of the second wire, said first and second eyes being pivotally interengaged.

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