

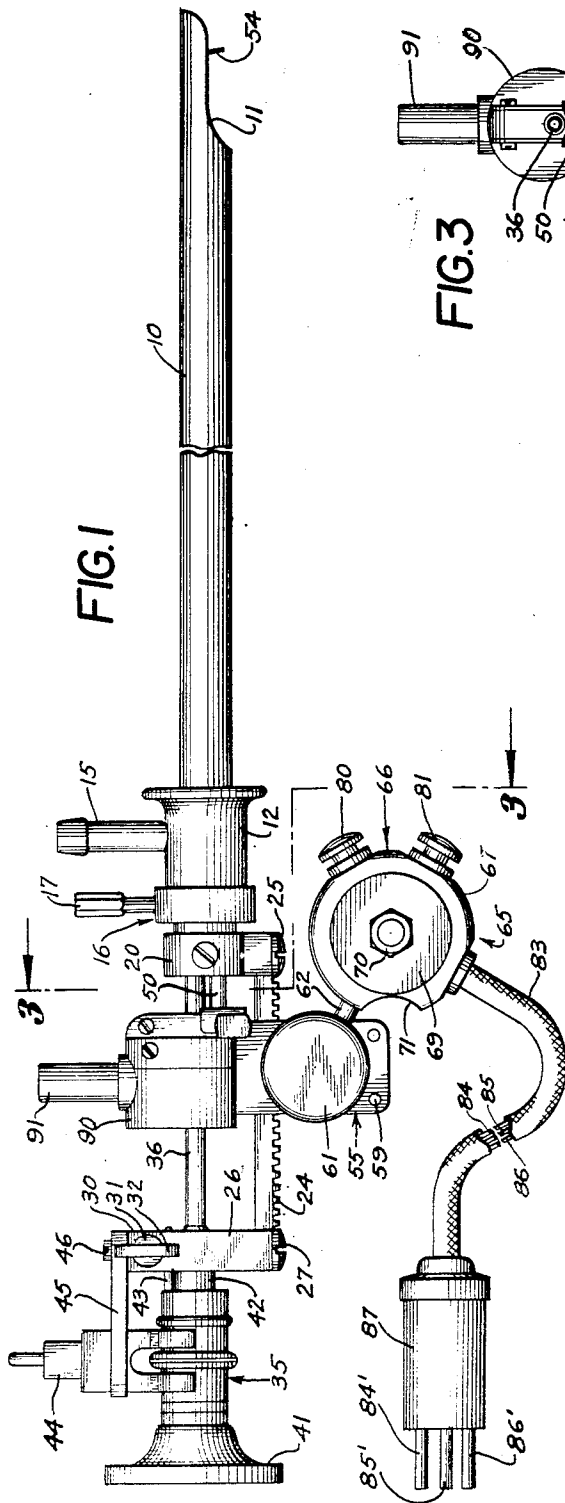
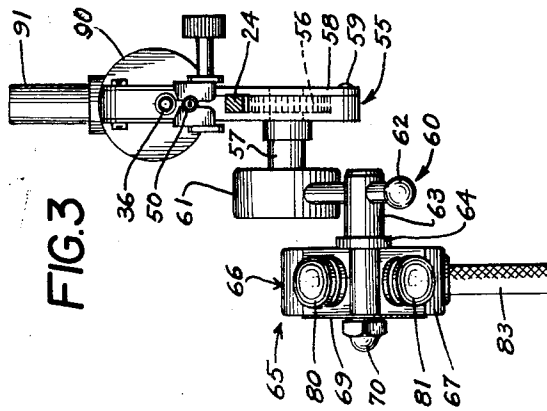
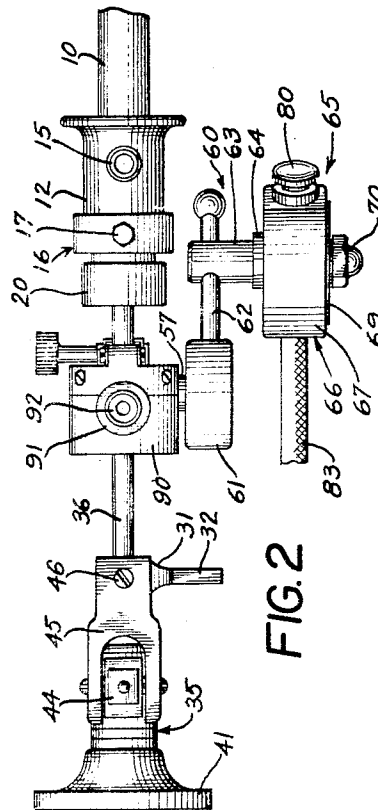
March 20, 1951

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ELECTROSURGICAL INSTRUMENT

2,545,865

Filed May 11, 1948

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

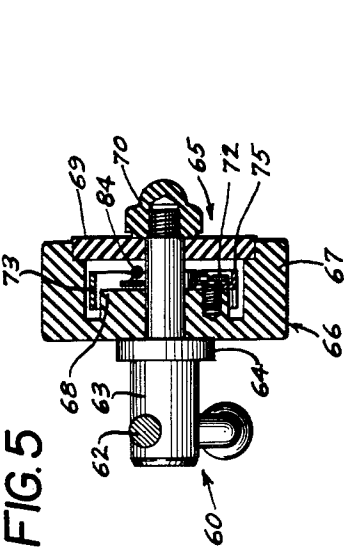


FIG. 5

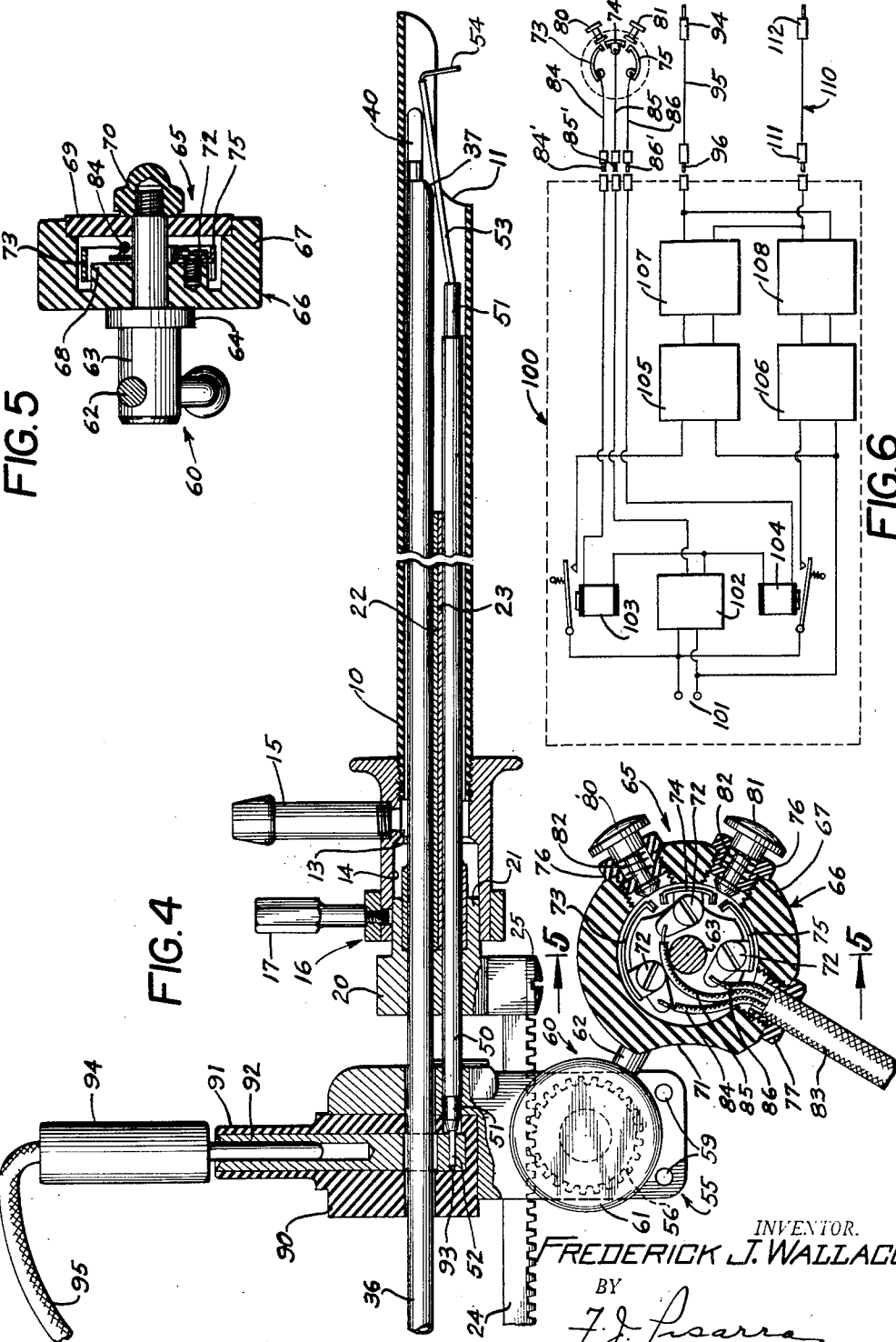
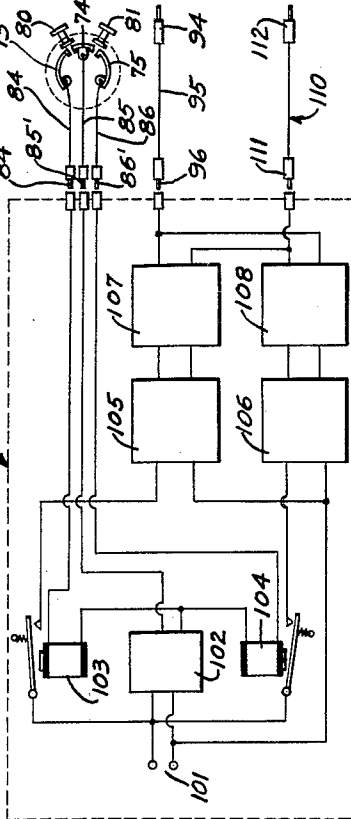


FIG. 4



UNITED STATES PATENT OFFICE

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ELECTROSURGICAL INSTRUMENT

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Application May 11, 1948, Serial No. 26,356

6 Claims. (Cl. 128—303.15)

1

This invention relates generally to a surgical instrument and has particular reference to an endoscopic instrument that is adapted to remove protrusions, tissue growths and the like, in body passages and cavities, with the aid of one or more high frequency electric currents.

A number of meritorious advances have been made in recent years in the art of electrosurgical resection of protrusions and tumorous growths in body passages, and cavities. In this connection, instruments have been devised whereby such protrusions and growths may be removed by the use of high frequency operating electrodes, manually movable arcuately or longitudinally with respect to their axes, under conditions of illuminated vision. It is generally the practice to connect the operating electrode of such an instrument with an electrical unit capable of supplying high frequency currents of different characteristics. The electrical unit is usually provided with a plurality of circuits, one of which furnishes a high frequency "cutting current" which permits the operating electrode to cut tissues with a minimum of trauma and substantially no accompanying searing or destruction of tissue. A second circuit furnishes a high frequency "coagulating current" which affords ample hemostatic effect in general surgical procedures; while a third circuit, having certain parts in common with the first and second circuits, furnishes a current that is a blend of the cutting and coagulating currents.

The control of the aforementioned circuits has in the past been effected by a treadle switch unit, connected to the electrical unit and operated by a foot of the surgeon operating the instrument. The treadle switch unit is usually connected to the electrical unit by a flexible cable so as to permit its disposition at a point remote from the electrical unit but proximate the location of the operating surgeon. By virtue of the movable character of the treadle switch unit, it may be accidentally moved around on the floor by the surgeon's foot during an operation, thereby making it necessary for the surgeon to grope for the switch unit and oftentimes interrupt the operation to make sure that he is actuating the proper control so as to obtain the desired current.

Even if such a switch unit is not accidentally moved out of the desired position, the surgeon is still under considerable strain in performing the operation, since he must manipulate the cutting electrode by hand and at the same time operate the switch unit by foot. It will be recog-

2

nized that the nervous strain imposed on the surgeon is compounded in situations where he is uncertain as to the exact position of the control elements of the switch unit.

The present invention obviates the difficulties experienced in the past as it provides an electrosurgical instrument which eliminates the need of foot switch units of the character indicated above. The parts of the instrument of this invention are so constructed and arranged that the surgeon may with one hand impart movement to the operating electrode and simultaneously control its electrical energization. This arrangement possesses a number of worthwhile advantages which will be readily apparent to persons versed in the art from the detailed description herein.

This invention has for its principal object the provision of an improved surgical instrument for removing protrusions, tissue growths and the like with the aid of at least one high frequency current.

Another object of the invention is to provide an endoscopic electrosurgical resecting instrument having a movable operating electrode that is adapted to be actuated and electrically energized simultaneously through the medium of a means under the control of one hand of the operator.

With the above and other objects in view, the invention comprises the devices, combinations and arrangements of parts set forth in the following detailed description and illustrated in the annexed drawings of a preferred embodiment of the invention, from which the several features of the invention, together with the advantages attainable thereby, will be readily understood by persons skilled in the art.

In the drawings:

Figure 1 is a view in side elevation of an instrument constructed in accordance with this invention, with parts broken away for better illustration;

Figure 2 is a top plan view of a portion of the instrument shown in Figure 1;

Figure 3 is a view taken along staggered line 3—3 of Figure 1;

Figure 4 is a view in enlargement corresponding to Figure 1, certain parts being shown in central vertical cross-section for better illustration, while other parts are omitted;

Figure 5 is a view taken along line 5—5 of Figure 4; and

Figure 6 is a diagrammatic representation of electric circuits and associated devices con-

tained in an electrical unit that is adapted to supply electric currents of different types or characteristics to the instrument depicted in Figure 1.

Referring now to the drawings, wherein like reference numerals denote corresponding parts throughout the several views, the instrument illustrated therein includes an endoscopic sheath 10 composed of an electrical insulating material, such as Bakelite, and having a fenestra 11 at its distal end. The rear end of sheath 10 is externally threaded for engagement with corresponding internal threads in a collar 12 to form a liquid-tight connection therewith and to establish communication between the interior of the sheath and a through passage 13 in the collar. As is shown in Figure 4, a portion 14 of passage 13 tapers outwardly in a rearward direction. Collar 12 carries an inlet conduit 15 communicating with passage 13 for the transmission of an irrigating liquid into the interior of sheath 10. Also secured to collar 12 is a locking unit 16 having a laterally extending handle 17. Locking unit 16 may be the same as or similar to the locking mechanism disclosed in R. H. Wappler Patent 1,880,551, granted October 4, 1932, to which reference may be had for details of construction.

A body 20, best shown in Figure 4, is provided with a frusto-conical forward portion 21 adapted to be inserted into tapered passage 14 and form a fluid-tight seal therewith. Body 20 carries a pair of parallel tubes 22 and 23 adapted, respectively, to accommodate the stem of a surgical telescope, hereinafter described, and to serve as a guide for an electrode rod, also hereinafter described. A rack 24 is secured at one end to body 20 by a screw 25, and at its other end to an arm 26 by a screw 27. Integral with arm 26 is a clamping sleeve 30 that carries a clamping screw 31 having a wing head 32.

A surgical telescope, generally indicated by numeral 35, comprises a tubular stem 36 that contains a lens system including an objective lens 37 (Figure 4). The remainder of the lens system (not shown) may be of any suitable type, such as, for example, the lens system disclosed in the patent to R. H. Wappler 1,680,490, granted August 14, 1928. A miniature lamp 40 is positioned at the forward end of tubular stem 36. At the rear of stem 36 is a conventional eyepiece 41 (Figure 1) adjacent which is a collar of intermediate diameter 42 and an aligning pin 43. When the instrument is assembled, as illustrated in several of the views, collar 42 and aligning pin 43 are disposed within clamping sleeve 30 and are secured thereto by the clamping action of screw 31. Electrical connections to miniature lamp 40 are made through suitable conventional devices, including a terminal post 44 mounted on telescope 35 and maintained in the illustrated position through the medium of a bracket arm 45 and a screw 46 that engages clamping sleeve 30.

A tubular electrode rod 50 is adapted to be inserted into guide tube 23 and longitudinally reciprocated therein. Rod 50 contains a mass of insulating material 51 within which an electrically conductive rod 52 is centrally imbedded. Conductive rod 52 merges at its forward end with a pair of forwardly and upwardly divergent arms 53, one of which is shown in Figure 4 and each of which is ensheathed in a suitable insulating material. Arms 53 terminate at their forward extremities in a generally transverse uninsulated electrically conductive operating electrode 54.

The rear end portion of conductive rod 52 is free of insulating material, as shown in Figure 4.

A housing, generally denoted by numeral 55, is slidably mounted upon rack 24 and contains a pinion 56 (Figure 3) that is rotatable with a shaft 57 and meshes with rack 24. Access to the interior of the housing and to pinion 56 may be gained by removing a cover plate 58 after attaching screws 59 are withdrawn (Figure 3).

A crank for imparting rotation to pinion 56 is generally indicated by numeral 60 and includes a cap 61 attached to the outer end of shaft 57, an arm 62 normal to the axis of shaft 57 and a second arm or shaft 63 attached to arm 62 and having an integral flange 64. As is best shown in Figure 3, the longitudinal axis of arm 63 is normal to arm 62 and parallel to the axis of shaft 57.

The outstanding feature of the invention resides in a combined handle and switch unit, generally indicated by numeral 65, for cooperating with other devices to respectively impart movement to the operating electrode and control the electrical energization thereof, as will be more fully explained further along. Unit 65 comprises a bipartite casing 66, formed of a suitable electric insulating material and consisting of a hollow base 67 having an inwardly projecting hub 68 freely rotatable about arm 63, and a cover 69. Casing 66 is restrained against axial movement by flange 64 and a cap screw 70 which threadably engages the outer end of arm 63 (Figure 5). The casing is formed with an arcuate peripheral recess 71, adapted to accommodate the thumb of the operator of the instrument. Wholly within casing 66 and affixed to base 67 by screws 72, is a series of spaced electric contact elements 73, 74 and 75. Each of a pair of hollow plugs 76 and a third hollow plug 77 is threadably connected to and disposed along a corresponding radius of casing 66. Plugs 76 are both positioned to the side of the axis of casing 66 remote from arcuate recess 71. Push buttons 80 and 81 are positioned in and slidable along corresponding hollow plugs 76 and are normally urged outwardly with respect to casing 66 by concentric helical springs 82 (Figure 4). A flexible cable 83 extends through plug 77 and is provided with three electrical conductors 84, 85 and 86 that are electrically connected to contact elements 73, 74 and 75, respectively. Cable 83 terminates in an electric plug 87 having prongs 84', 85' and 86', corresponding, respectively, to conductors 84, 85 and 86.

A block of insulating material 90, such as hard rubber, is carried by housing 55 and accommodates a binding post 91 having an electrically conductive hollow core 92. Core 92 is formed with an opening 93 to frictionally engage and form electrical contact with the rear end of conductive rod 52 (Figure 4). A single-prong electric plug 94 is adapted to be removably inserted in hollow core 92 and is connected to a flexible conductor 95 having a like plug 96 at its other end.

Each of plugs 87 and 96 is adapted to be connected to an electrical unit 100 that is illustrated generally and diagrammatically in Figure 6. Unit 100 is adapted to be connected through a terminal 101 to a suitable source of electric supply and preferably includes a six-volt transformer 102, a pair of electric relays 103 and 104, and a pair of transformers 105 and 106. Unit 100 may be of any construction known to the art and is of the type capable of furnishing high frequency "cutting" and "coagulating" currents of the character described earlier here-

5

in, and a blend of such currents. A vacuum tube circuit for furnishing the cutting current is indicated by numeral 107, while a spark-gap circuit for furnishing the coagulating current is indicated by numeral 108. An insulated conductor 110, having a plug 111 for connection to unit 100 and an indifferent electrode 112 for connection to the body of the patient, constitutes a portion of the return leg of the circuit during an operating procedure.

For the purpose of outlining briefly the operation of the present invention, it is first assumed that the instrument of Figure 1 is assembled with the endoscopic sheath inserted in a body passage so that electrode element 54 is in the region of body tissue to be removed, that illumination is being supplied to miniature lamp 40, that plug 94 is in contact with hollow core 92 and plug 96 is connected to unit 100, that indifferent electrode 112 of conductor 110 is connected to the body of the patient and plug 111 is connected to unit 100, and that plug 87 is connected to unit 100. The surgeon sights through telescope eyepiece 41 and grasps unit 65 with the thumb and first two fingers of his right hand, the thumb being positioned in arcuate recess 71, the end portion of the forefinger resting on push button 80, and the end portion of the middle finger resting on push button 81. He may now manipulate unit 65 to thereby impart rotation to crank 60 and corresponding reciprocatory movement to the electrode and simultaneously control the energization of the electrode by the high frequency cutting current, the coagulating current, or a blend thereof, by respectively depressing push button 80, push button 81, or both push buttons 80 and 81.

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 the form of my invention herewith shown and described is to be taken as a preferred example of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of my invention as defined by the appended claims.

I claim:

1. In an instrument of the character described, an endoscopic tube, an electrode rod reciprocable in the tube and adapted to be connected to a suitable source of electric current supply, and means connected to the electrode rod and adapted to be connected to the source of electric current supply for simultaneously imparting reciprocatory movement to the electrode rod and controlling electrical energization thereof, said means comprising a shaft rotatable about an axis normal to the path of reciprocatory movement of the electrode rod, means for translating rotary movement of the shaft into reciprocatory movement of the electrode rod, an arm connected to the shaft, said arm being offset from and parallel to the shaft, and an electric switch unit mounted on and rotatable about the axis of the arm and adapted to be connected to the source of electric current supply.

2. In an instrument of the character described, an endoscopic tube, an electrode rod reciprocable in the tube and adapted to be connected to a suitable source of electric current supply, and means connected to the electrode rod and adapted to be connected to the source of electric current supply for simultaneously imparting reciproca-

6

tion to the electrode rod and controlling electrical energization thereof, said means comprising a crank rotatable about an axis normal to the path of reciprocatory movement of the electrode rod, means for translating rotational movement of the crank into reciprocatory movement of the electrode rod, and an electric switch unit secured to the crank and freely rotatable with respect thereto about an axis parallel to the axis of rotation thereof, said switch unit being adapted to be connected to the source of electric current supply.

3. In an instrument of the character described, an endoscopic tube, an electrode rod movable in the tube and adapted to be connected to a source of supply of a plurality of electric currents having different characteristics, and means connected to the electrode rod and adapted to be connected to said source for simultaneously imparting movement to the electrode rod and controlling electrical energization thereof, said means comprising a rotary shaft, means for translating rotary movement of the shaft into corresponding movement of the electrode rod, an arm connected to the shaft, said arm being offset from and parallel to the shaft, and an electric switch unit mounted on and rotatable about the axis of the arm, said switch unit including a plurality of circuit closing devices so arranged as to permit energization of the electrode rod by any selected current supplied by said source.

4. In an instrument of the character described, an endoscopic tube, an electrode rod movable in the tube and adapted to be connected to a source of supply of a plurality of electric currents having different characteristics, and means connected to the electrode rod and adapted to be connected to said source for simultaneously imparting movement to the electrode rod and controlling electrical energization thereof, said means comprising a rotary shaft, means for translating rotary movement of the shaft into corresponding movement of the electrode rod, an arm connected to the shaft, said arm being offset from and parallel to the shaft, and an electric switch unit comprising a casing rotatable about the axis of the arm, a plurality of spaced circuit closing push buttons so arranged as to permit energization of the electrode rod by any selected current supplied by said source, and means for normally and yieldingly maintaining each push button in circuit opening position.

5. In an instrument of the character described, an endoscopic tube, an electrode rod reciprocable in the tube and adapted to be connected to a source of supply of a plurality of electric currents having different characteristics, and means connected to the electrode rod and adapted to be connected to said source for simultaneously imparting reciprocatory movement to the electrode rod and controlling electrical energization thereof, said means comprising a rotary shaft, means for translating rotary movement of the shaft into reciprocatory movement of the electrode rod, an arm connected to the shaft, said arm being offset from and parallel to the shaft, and an electric switch unit comprising a casing rotatable about the axis of the arm, a plurality of push buttons angularly spaced and slidable along corresponding radii of the arm and so arranged as to permit energization of the electrode rod by any selected current supplied by said source.

6. In an instrument of the character described, an endoscopic tube, an electrode rod reciprocable in the tube and adapted to be connected to a source of supply of a plurality of electric currents

having different characteristics, and means connected to the electrode rod and adapted to be connected to said source for simultaneously imparting reciprocation to the electrode rod and controlling electrical energization thereof, said 5 means comprising a rotary shaft, means for translating rotary movement of the shaft into reciprocatory movement of the electrode rod, an arm connected to the shaft, said arm being offset from and parallel to the shaft, and an electric switch unit comprising a generally circular casing mounted on and rotatable about the axis of the arm and having a peripheral recess, and a plurality of angularly spaced and radially arranged push buttons extending outwardly beyond the 15 casing to the side thereof remote from said recess.

FREDERICK J. WALLACE.

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