

United States Patent

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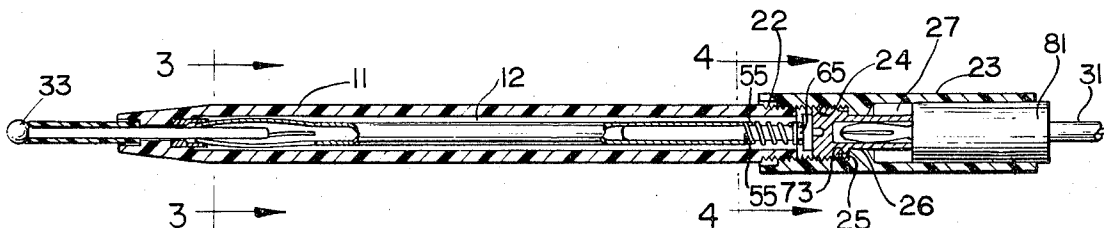
[50] Field of Search..... 128/303.13
 303.19; 174/46

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[54] **ELECTROSURGICAL INSTRUMENT**
15 Claims, 7 Drawing Figs.
 [52] U.S. Cl.....128/303.13,
 128/303.17
 [51] Int. Cl.....A61b 17/36

ABSTRACT: An electrosurgical instrument with interchangeable electrode tips. The electrode tips are firmly held in place in a spring biased chuck which allows the tips to be readily removed and reinserted.



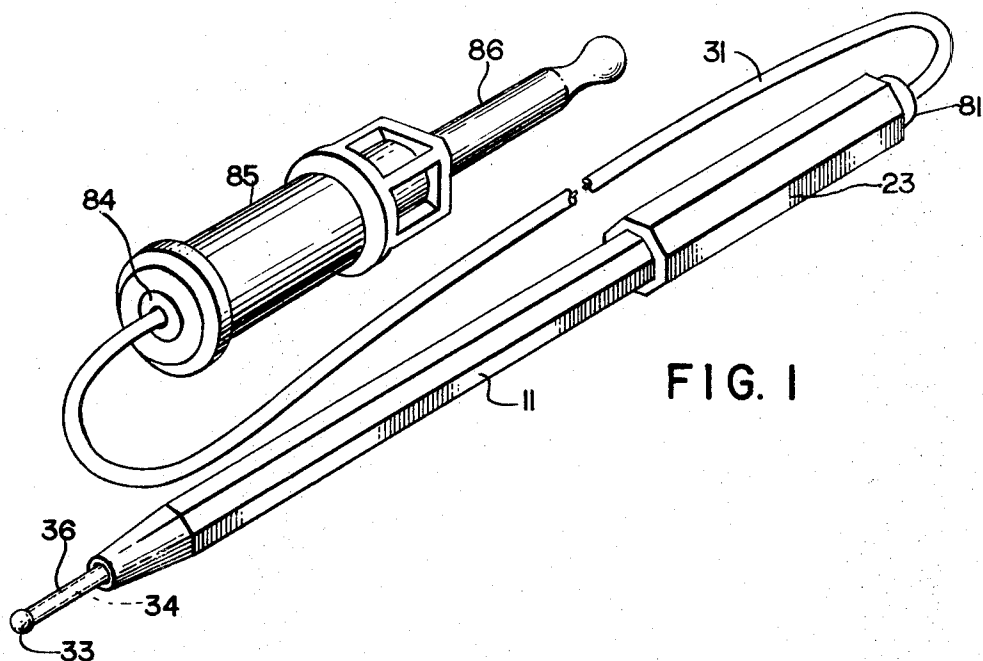


FIG. 1

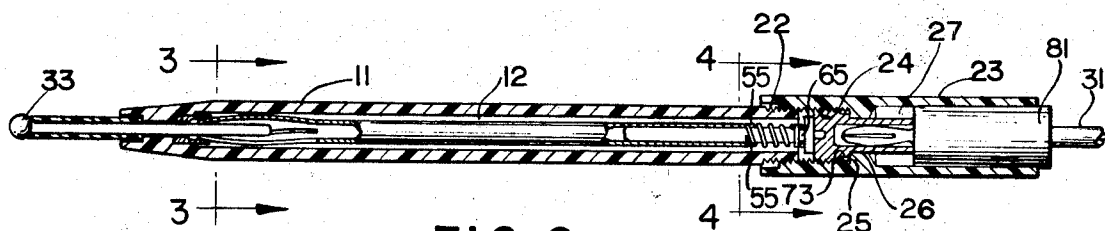


FIG. 2

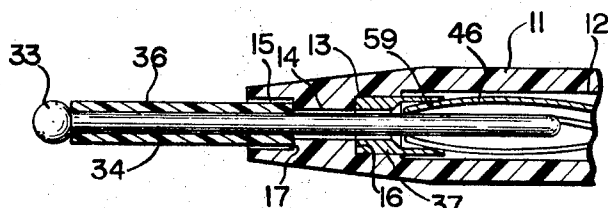


FIG. 5

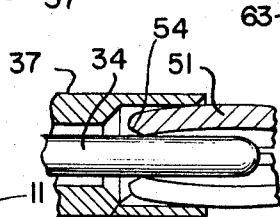


FIG. 5A

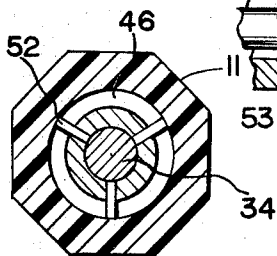


FIG. 3

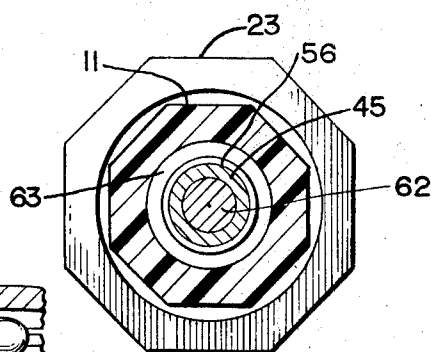


FIG. 4

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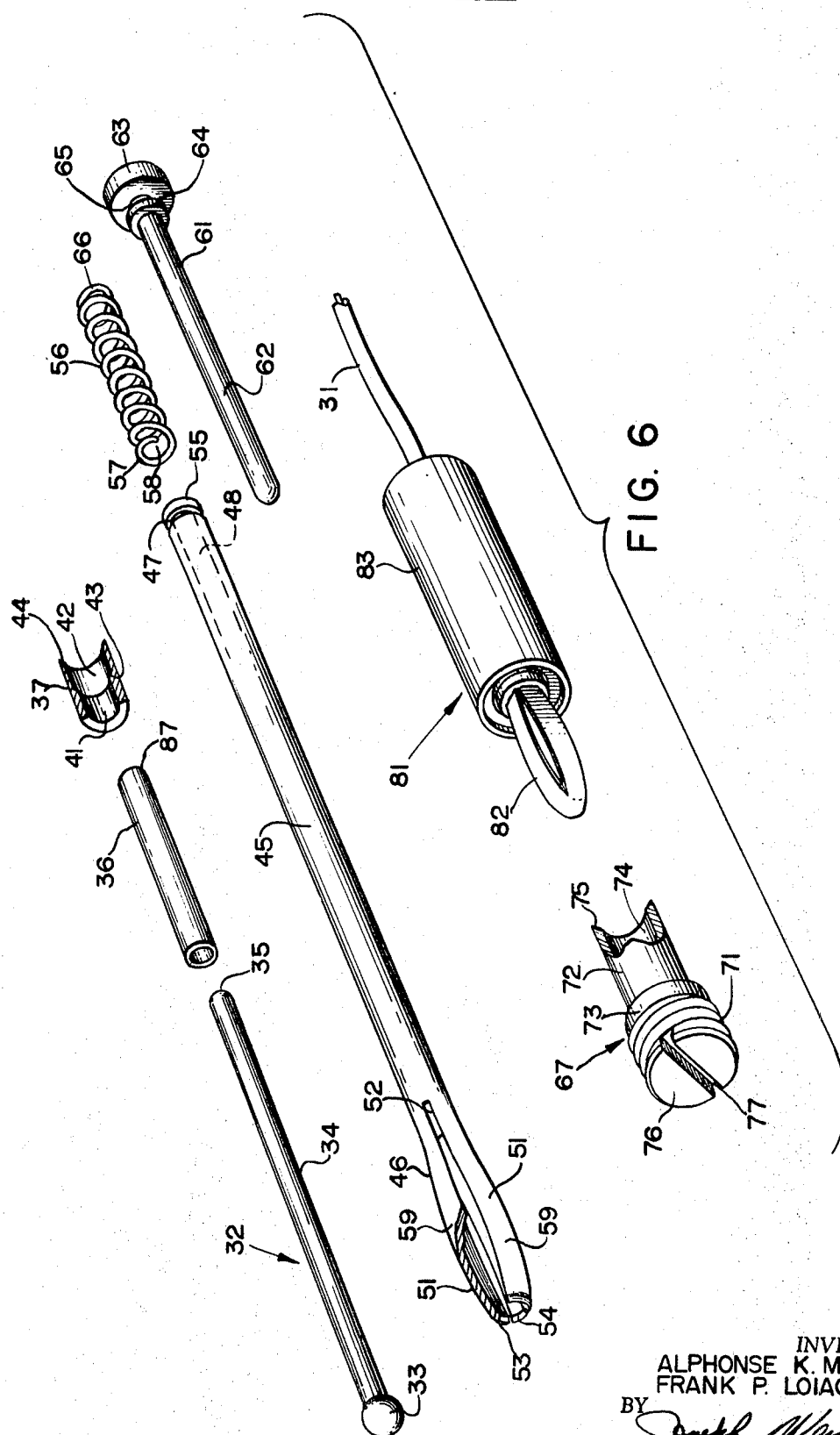


FIG. 6

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ELECTROSURGICAL INSTRUMENT

FIELD OF THE INVENTION

This invention relates in general to surgical instruments and more particularly concerns a novel sterilizable electrosurgical instrument having interchangeable electrodes.

DISCUSSION OF THE PRIOR ART

Electrosurgery is a form of surgery in which body tissue is removed or destroyed by heat generated by an alternating high-frequency current, and is accomplished by any one of three methods: electrodesiccation, electrosection, and electrocoagulation. All of these methods use an active and indifferent electrode. Using electrosection as an example, the indifferent electrode may be a large metal plate which is placed on the arm, leg or back of the patient. The active electrode may have a wide variety of shapes such as a needle for cutting or a wire loop for scraping. Tissue touched by the active electrode is disintegrated but the heat generated by the instrument does not penetrate deeply into body tissues. In this manner, the active electrode functions as a knife. A particular advantage of this type of surgery is that small blood vessels are sealed by the heat and bleeding is thereby controlled during the surgical operation.

Various instruments have been developed which are intended for use in electrosurgery. These devices disclose different means for attaching an active electrode into an insulating handle and applying electrical power thereto. The electrode in these devices is often shown adjustable in length by means of a setscrew and may be removed from the handle when the setscrew is sufficiently loosened. However, these devices do not allow for easy interchangeability of the active electrode since a setscrew must be loosened or tightened, often by means of a suitable tool such as a screwdriver.

The electrosurgical instruments which have been designed for rapid interchangeability have used several means for releasing the electrode tip from the handle. However, some of these devices have suffered from the fact that the electrode tip release may be accidentally tripped resulting in possible ejection of the electrode during surgery or at other inopportune moments. Also, many of such mechanical devices are somewhat cumbersome or are not properly balanced for close surgical use where a certain "feel" is necessary for the surgeon to properly use the instrument.

SUMMARY OF THE INVENTION

The novel electrosurgical pencil of this invention provides an insulative handle containing a chuck which holds the shank of an active electrode in a positive manner while allowing the electrode to be easily removed or replaced simply by pulling it outward from the end of the chuck or by inserting it into the chuck. No separate mechanical release means is required, thus eliminating the problem of accidental release. The instrument is carefully machined and balanced to ensure the feel that is so necessary in surgical operations.

Broadly speaking, the chuck employs flexible grasping fingers urged into a closed position by means of a spring which longitudinally biases the tapered flexible fingers of the chuck into a bushing within the electrode end of the handle. The active electrode shank is inserted into the end of the handle where it is firmly gripped by the chuck. An electrically insulative sleeve surrounds that portion of the shank which protrudes from the handle so that only the tip of the active electrode is exposed. The sleeve abuts a shoulder within the electrode end of the handle thereby providing a positive stop when the shank is inserted into the chuck. The opposite or connecting end of the handle is provided with an electrical receptacle which may be adapted to receive a banana plug or other suitable type connector. An electrical path from the receptacle to the electrode is provided through the chuck.

The materials of the instrument are sterilizable so that when the power is disconnected and the active electrode removed, the handle may be autoclaved or otherwise sterilized. The

electrode tips may be cleaned and sterilized separately and later connected to the handle, or the handle and electrode may remain interconnected and sterilized together so that they are made ready as a unit for their next use.

BRIEF DESCRIPTION OF THE DRAWING

The features and advantages of the invention will become apparent from the following detailed description when read in conjunction with the accompanying drawing, in which:

FIG. 1 is a perspective view of an electrosurgical instrument constructed in accordance with the principles of this invention;

FIG. 2 is an elevational view in section of the instrument of FIG. 1;

FIG. 3 is a sectional view taken through cutting plane 3-3 of FIG. 2;

FIG. 4 is a sectional view taken through cutting plane 4-4 of FIG. 2;

FIG. 5 is an enlarged sectional view of the electrode end of the instrument as shown in FIG. 2;

FIG. 5A is an enlarged sectional view of the gripping end of the chuck shown in FIG. 5; and

FIG. 6 is an exploded view of the elements which are disposed within the handle of the instrument.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, handle 11 is a substantially rigid elongated hollow tube. It is shown with a plurality of flat sides which permit it to be firmly gripped by the operating surgeon. Main bore 12 in handle 11 extends from the connecting end (at the right in the drawing) to a point adjacent the electrode end at which end are formed smaller bores 13, 14 and 15. Bore 14 is smaller than bores 13 and 15 and provides a neck between them forming shoulder 16 facing inward and shoulder 17 facing outward toward the electrode tip. The connecting end of handle 11 is formed with threads 22 on its exterior surface. Adaptor 23 has threads 24 formed in the interior surface of one end thereof extending from a point near the end surrounding handle 11 to shoulder 25 which is defined by reduced diameter bore 26, which threads mate with handle threads 22. Counterbore 27 extends throughout the remainder of adaptor 23. When adaptor 23 is screwed onto the connecting end of handle 11, it forms an enlarged continuation thereof. Handle 11 and adaptor 23 are both electrically insulative and may be made of a suitable sterilizable, rigid and substantially unbreakable plastic of a type well known in the art. Certain suitable plastics are sufficiently rigid to be machined, in which case threads 22 and 24 may be machined into their respective parts to ensure a smooth, close fit.

Turning specifically to FIG. 6, the mechanical elements within the handle and the adaptor will now be described in detail. Electrode 32 is comprised of shank 34 which has enlarged tip 33 and smoothly rounded opposite end 35. It should be noted that the tip of the electrode may be any desired shape as required for the particular surgical situation at hand. For enhanced electrical and surgical properties, electrode 32 will preferably be made of stainless steel. An electrically insulative sleeve 36 is snugly fitted over shank 34 and abuts tip 33. Sleeve 36 is made of a sterilizable plastic such as nylon or polytetrafluoroethylene and is substantially shorter than shank 34. Its functions will be fully discussed below.

Bushing 37 is force fitted within bore 13 of handle 11 and is seated against shoulder 16 therein. This bushing may be made of any suitable material such as brass. It is, however, quite possible that bushing 37 may be eliminated by properly shaping the interior of handle 11 to perform the same function. Bushing 37 is provided with bore 41 and counterbore 42. The transitional surface 43 is tapered inwardly, as is edge 44 which defines the opening of counterbore 42.

Hollow tubing 45 is an electrically conductive member formed with electrode gripping chuck 46 at one end and annular spring retaining groove 47 at the other. Tubing 45 is

preferably made of spring steel having a coextensive longitudinal bore 48. Silver plating may be used on contacting surfaces of tubing 45 for enhanced electrical conductivity if desired. As shown in the drawing, chuck 46 is formed of three outwardly bowed fingers 51 separated by milled grooves 52, each finger having bowed outer surface 59. The tips of fingers 51 have rounded external surfaces 53 and beveled surfaces 54 sloping inward, as is clearly shown in FIG. 5A. The axial opening normally formed by the beveled surfaces 54 of fingers 51 is slightly smaller in diameter than rounded end 35 of electrode 32 so that the fingers are forced slightly apart upon insertion of the electrode, but because of their spring quality, firmly grip the electrode when thus spread. This gripping operation and mechanism will be further discussed below. At the opposite end of tubing 45 is annular groove 47 which defines annular ridge 55. End coil 57 of spring 56 is seated in groove 47 so that contact between the spring and tubing 45 will be maintained whether spring 56 is in tension or compression. It should be understood that, although a coil spring 56 is shown as a specific biasing means herein, the invention contemplates other biasing means which perform the same function.

Plunger 61 has a shank 62 slightly smaller than axial bore 48 in tubing 45 and also smaller than axial opening 58 through coil spring 56. Plunger 61 is provided with a flat contact head 63 and an annular ridge 64 which is separated from head 63 by annular groove 65. End coil 66 of spring 56 is seated in groove 65 to maintain contact between the spring and the plunger. Plunger 61 is thus slidably and resiliently coupled to tubing 45 by means of spring 56. Shank 62 extends through axial opening 58 in spring 56 and into bore 48 in tubing 45. Coils 57 and 66 engage tubing 45 and plunger 61 respectively, thereby interconnecting the plunger and the tubing. Spring 56 is normally in compression, thereby biasing chuck 46 away from contact head 63. This operative relationship will be referred to again later.

Connector 67 is made of electrically conductive material and is provided with threads 71 at one end separated from cylindrical shank 72 at the other end by shoulder 73. Shank 72 is provided with longitudinal blind bore 74 having beveled edges 75 at its opening. Threads 71 are configured to mate with threads 24 in adaptor 23. Flat end 76 of connector 67 is provided with a crosswise slot 77 shaped to receive a screwdriver blade for screwing the connector into adaptor 23. When connector 67 is properly mounted in adaptor 23, shoulder 73 abuts shoulder 25 and shank 72 extends through bore 26 into counterbore 27.

Electrical cable termination 81 is a type well known in the art as a banana plug. Cable 31 is suitably connected to flexible electrically conductive male contacting member 82 internally of electrically insulating sleeve 83. The internal electrical connection is preferably the well known swivel type to thereby prevent cable 31 from becoming twisted and entangled during use. The diameter of sleeve 83 is slightly less than the diameter of counterbore 27 in adaptor 23. The banana plug is adapted to be removably connected to the instrument by insertion into adaptor 23. The rounded end of contacting member 82 is guided into connector bore 74 by means of beveled edge 75. The spring action of flexible contacting member 82 provides a firm frictional engagement between banana plug 81 and connector 67.

The other end of cable 31 terminates in a second swivel type banana plug 84, as shown in FIG. 1. Plug 84 may then be coupled to a suitable adaptor plug 85 which is in turn connected to a source of electrical power (not shown) by means of electrically conductive shank 86. Plug 85 may have shanks of various shapes and sizes to fit different electrical outlets. Differences in power outlets will not affect use of this novel electrosurgical instrument and its power cable because of its universal type banana plug terminations. The only element which is subject to modification to fit different electrical outlets is the removable adaptor plug 85.

In accordance with the novel principles of this invention, the fully assembled instrument, as shown in FIGS. 1 and 2

(disregarding for the moment the interchangeable electrode), is electrically continuous from cable 31 through the conductive members within the handle and adaptor to chuck 46. The internal members comprise essentially of connector 67 having flat end 76 which bears against contact head 63 of plunger 61, thereby partially compressing spring 56 and forcing chuck 46 into counterbore 42 of bushing 37. As fingers 51 enter bushing 37, bowed outer surfaces 59 bear more heavily against the surface of counterbore 42 and tend to urge fingers 51 together. When the chuck is fully inserted into bushing 37, rounded ends 53 of fingers 51 bear against tapered shoulder 43 in the bushing forcing the fingers together in substantially closed condition. The assembled electrosurgical instrument is thus conditioned to receive surgical electrode 32 when chuck 46 is biased as far as possible into bushing 37.

Bore 14 in handle 11 is slightly larger than electrode shank 34 and is substantially the same diameter as bore 41 in bushing 37. Likewise, bore 15 is somewhat larger than insulative sleeve 36 and substantially larger than shank 34. With end 35 of electrode shank 34 being smoothly rounded, electrode 32 may be easily inserted into the electrode end of handle 11 without careful and time consuming aiming. The configuration of this end of the electrode allows it to slide off shoulder 17 into bore 14 and directly into the circle formed by beveled surfaces 54 of chuck fingers 51. Increasing the insertion force on the electrode causes tubing 45 to yield longitudinally in handle bore 12, further compressing spring 56. In response to this longitudinal motion, rounded ends 53 of chuck fingers 51 retreat from tapered shoulder 43 of bushing 37 and rounded surfaces 59 bear less heavily on the side of counterbore 42, allowing chuck 46 to be opened slightly to admit the end of electrode shank 34. However, the biasing action of spring 56 continuously urges chuck 46 into bushing counterbore 42. Thus, the biasing action of spring 56 ensures that electrode shank 34 is firmly gripped at all times by chuck 46. The force with which chuck 46 grips the electrode shank is such that the electrode is firmly held but may be readily removed by pulling with the fingers or with a suitable mechanical tool such as forceps. A certain satisfying positive gripping action is evident when the electrode is inserted or removed.

An important concept of this novel instrument resides in insulative sleeve 36. This sleeve functions to provide a positive stop when electrode 32 is inserted into handle 11. The sleeve fits tightly around shank 34 and abuts tip 33, which thereby prevents its longitudinal movement past the electrode tip. When the electrode is in place, end 87 of the sleeve abuts shoulder 17 in handle 11. Sleeve 36 may be made any practical length shorter than shank 34 to provide any desired length of electrode extending from the electrode end of handle 11, provided that sufficient length of shank 34 remains exposed to pass through bores 14 and 41 to be gripped by chuck 46. Since bore 15 is larger than sleeve 36, slight variations in the wall thickness of the sleeve are acceptable and will not adversely affect the instrument.

It should be noted that handle bore 15 provides a particularly significant and novel safety feature. It is possible that the electrode may, by accident, be not fully inserted or that it could be partially pulled out of chuck 46 during handling and use. Bore 15 allows substantial longitudinal play of this type without resulting in any danger to the operator from electrical shock because the shank of electrode 32 is fully protected by sleeve 36 throughout its exposed length plus the length of bore 15. With the electrical power used in such instruments, this feature is significant from the standpoint of physical safety. It can be appreciated that during an operation, the surgeon's fingers might slip off or overlap from handle 11 onto the shank of electrode 32. If sleeve 36 was constructed to abut the very end of the handle, it is quite possible that a gap could exist between the sleeve and the insulative handle, exposing a portion of electrode shank 34 which could come in contact with the surgeon's hand. With the invention herein described, it is unlikely that electrode 32 will slide out sufficiently far to expose a portion of shank 34 between the handle and sleeve 36,

but should such a condition occur, it will be detected by the increased protruding length of the electrode or by the fact that the electrode is not then held securely motionless in the handle or both. The size of bore 14 allows slight wobbling of the electrode to occur when sleeve 36 is not firmly butted against shoulder 17.

With the electrode firmly in place, an electrical path is provided from adaptor plug 85 through cable 31 to banana plug 81, thence through connector 67, plunger 61 and spring 56, shank 45 and chuck 46 to electrode 32. All electrically conducting contacting parts may be silvered if desired or if necessary for proper conductivity at the contacting surfaces.

Electrodes having tips with different shapes and sizes are readily accommodated by the novel instrument herein described. Similar electrodes may extend different distances from the handle depending upon the length of sleeve 36.

Having described one embodiment of this invention in detail, certain modifications and improvements will now occur to those skilled in this art. It is intended that the scope of the invention disclosed herein be limited only by the appended claims.

We claim:

1. An electrosurgical instrument, comprising:

an elongated electrically insulative handle having an electrical connection end, an electrode receiving end and a longitudinal bore therethrough;

a surgical electrode having a shank for insertion into said receiving end;

an electrically conductive chuck longitudinally movable within said bore and formed with a plurality of flexible fingers in the region of said electrode receiving end, the ends of said fingers normally defining an axial opening smaller in cross section than said shank of said surgical electrode, said fingers being adapted to engage and releasably grip said shank of said surgical electrode;

means at said electrical connection end for receiving an electrical power cable for electrical connection to said conductive chuck;

means within said handle normally biasing said chuck toward said electrode receiving end;

said chuck being further adapted to yield longitudinally against said biasing means upon insertion of said shank into said axial opening defined by said fingers, said fingers being thereby spread to receive said shank; and

means coacting with said biasing means during the spread of said fingers for continuously urging said fingers into gripping engagement with said shank.

2. The electrosurgical instrument recited in claim 1, wherein the cross section of said surgical electrode shank and said axial opening are generally circular.

3. The electrosurgical instrument recited in claim 2, and further comprising an electrically insulative sleeve closely surrounding a portion of the length of said electrode shank, said sleeve being substantially shorter than said shank.

4. The electrosurgical instrument recited in claim 3, wherein:

said longitudinal bore through said handle is comprised of a first bore at said electrode receiving end, a smaller bore longitudinally adjacent thereto and a larger main bore extending throughout the remainder of said handle, said smaller bore defining a shoulder at the junction with said first bore;

said smaller bore being shaped and configured to receive said surgical electrode shank but smaller than the diameter of said sleeve;

said first bore being shaped and configured to receive said insulative sleeve; and

whereby one end of said sleeve abuts said shoulder and determines the extent to which said shank may be inserted into said electrode receiving end.

5. The electrosurgical instrument recited in claim 4, wherein:

said surgical electrode has an exposed tip at one end and is smoothly convex at the other end;

said sleeve abuts said exposed tip; and

said convex end is adapted to be inserted through said electrode receiving end of said handle into said chuck.

6. The electrosurgical instrument recited in claim 5, wherein the ends of said fingers defining said axial opening are beveled inward, said beveled surfaces being adapted to receive and center said smoothly convex end of said electrode.

7. The electrosurgical instrument recited in claim 6, wherein said means for continuously urging said fingers into gripping engagement with said shank is a bushing mounted within said main bore at said electrode receiving end, said bushing abutting said smaller bore, said bushing having a bore of substantially the same size as said smaller bore and a counterbore adapted to receive the fingers of said chuck.

8. The electrosurgical instrument recited in claim 7, wherein:

said fingers are bowed outwardly and the transitional surfaces between the external bowed sides of said fingers and said inward beveled surfaces are smoothly convex;

the edge of said counterbore in said bushing is beveled inwardly and the transitional surface between said counterbore and said bore in said bushing is beveled inwardly; and

whereby said chuck fingers are guided into said bushing counterbore by said beveled edge, said bowed sides of said fingers bear against the side of said counterbore urging said fingers together under the action of said biasing means, and said smoothly convex surfaces of said fingers in biased contact with said beveled transitional surface in said bushing urges said fingers tightly closed, said axial opening being thereby substantially smaller than said electrode shank.

9. The electrosurgical instrument recited in claim 1, wherein said biasing means is an electrically conductive spring normally under compression between said chuck and said electrical power cable receiving means, said spring providing electrical connection between said chuck and said electrical power cable receiving means.

10. The electrosurgical instrument recited in claim 7, wherein said first bore and said smaller bore together are substantially shorter than said electrode shank, whereby that portion of said shank which is free of said sleeve extends through said smaller bore and said bore in said bushing into said chuck.

11. A handle for use with and adapted to interchangeably and firmly receive a surgical electrode having a shank, said handle comprising:

an elongated electrically insulative body having an electrical connection end, an electrode receiving end and a longitudinal bore therethrough;

an electrically conductive chuck adapted to engage and releasably grip the shank of said surgical electrode, said chuck being longitudinally movable within said bore and formed with a plurality of flexible fingers in the region of said electrode receiving end, the ends of said fingers normally defining an axial opening smaller in cross section than the electrode shank which said chuck is adapted to receive;

means at said electrical connection end for receiving an electrical power cable for electrical connection to said conductive chuck;

means within said body normally biasing said chuck toward said electrode receiving end;

means coacting with said biasing means for continuously urging said fingers together; and

said chuck being adapted to yield longitudinally against said biasing means to enable said fingers to spread apart sufficiently to forcibly receive said electrode shank.

12. The handle recited in claim 11, wherein said biasing means is an electrically conductive spring which is normally in compression and provides electrical contact between said chuck and said electrical power cable receiving means.

13. The handle recited in claim 12, wherein:

said means for continuously urging said fingers together is a bushing fixed within the electrode receiving end of said

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body, said bushing having a bore and a counterbore with a beveled transitional surface between them and an inwardly beveled edge at the entrance to said counterbore; said chuck is adapted to enter said counterbore under the action of said spring; and wherein
said fingers are shaped and configured to be urged together as said chuck is biased into said bushing.

14. The handle recited in claim 13, wherein said longitudinal bore in said body comprises a first bore at said electrode

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receiving end, a smaller bore longitudinally adjacent thereto and a larger main bore extending throughout the remaining length of said body, the transitional surface between said first bore and said smaller bore being normal to the axis of said bores and defining a shoulder facing said electrode receiving end.

15. The handle recited in claim 14, wherein the bore in said bushing is substantially the same size as said smaller bore.

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