United States Patent [19]

Justus, et al.

[11] **3,895,635**

[45] **July 22, 1975**

[54] **ELECTROSURGICAL GROUNDING CABLE ASSEMBLY**

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[22] Filed: **June 20, 1973**

[21] Appl. No.: **371,773**

[52] **U.S. Cl.**..... **128/303.13;** 128/2.06 E; 128/404; 128/D.4; 339/65; 339/274

[51] **Int. Cl.**..... **A61n 1/04**

[58] **Field of Search** ..... 128/2.06 E, 2.1 E, 303.13, 128/303.14, 303.17, 303.18, 404, 416, 417, 418, 415, 414, 413, 412, 411, 410; 339/39, 42, 65, 79, 101, 273 F, 274

[56] **References Cited**

UNITED STATES PATENTS

2,556,491	6/1951	De Lorenzo	339/274
2,590,886	4/1952	Pederson	339/274
3,671,924	6/1972	Nagano	339/274
3,699,968	10/1972	Bolduc	128/416
3,720,209	3/1973	Bolduc	128/416
3,750,094	7/1973	Zenkich	128/2.06 E

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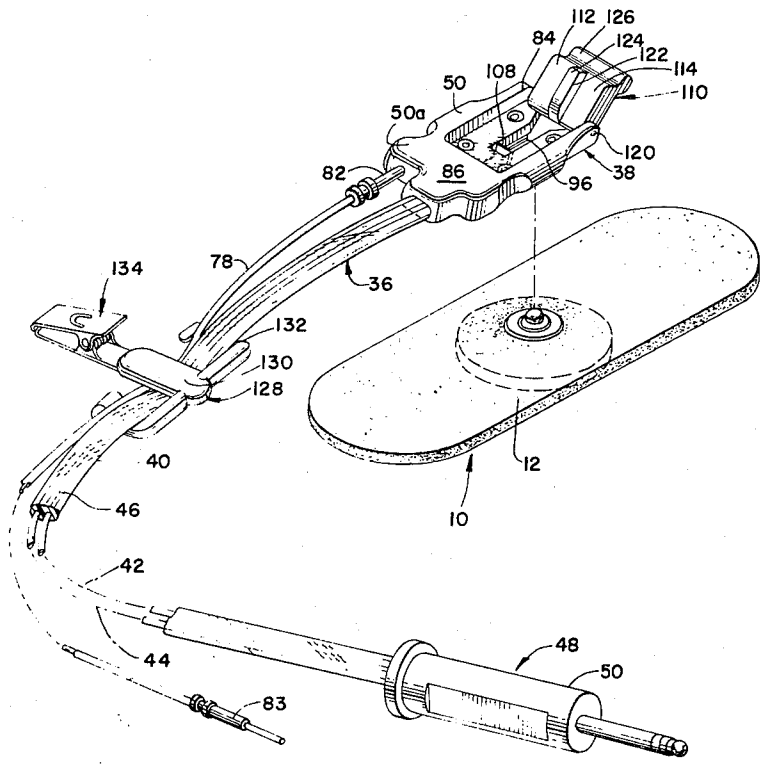
[57] **ABSTRACT**

A connector for the grounding cable of an electrosurgical generator (E.G.) has a non-conductive body carrying an electrical contact plate against which a stud of an indifferent electrode in an electrosurgical grounding pad is locked by a non-conductive cam lever pivotally mounted on the body portion. The body has one end of the grounding cable located therein in attachment to the contact plate with the other end of the grounding cable having a terminal plug for insertion in a socket of the electrosurgical generator.

As an adjuvant feature, the body has a receptacle engaged with the contact plate and adapted to receive a pin jack on a grounding wire for interconnecting a monitoring patient cable ground circuit of an electrocardiograph machine (E.K.G.) and the electrosurgical patient grounding cable.

21 Claims, 9 Drawing Figures



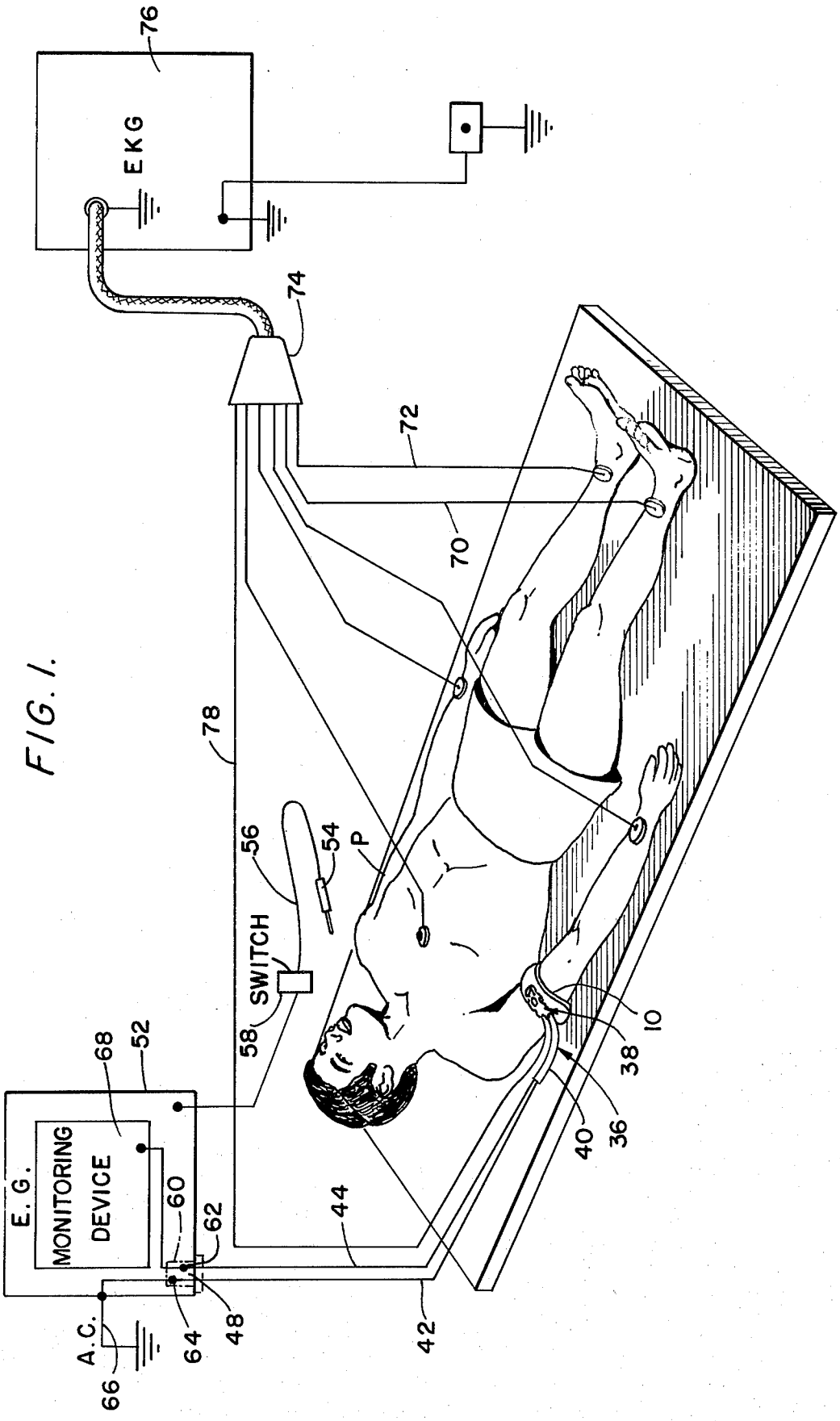

76
EKG
74
72
70
78
56
54
P
SWITCH
58
68
52
E. G.
MONITORING
DEVICE
60
62
64
48
66
A.C.
44
42
40
36
38
10

FIG. 1.

FIG. 7.

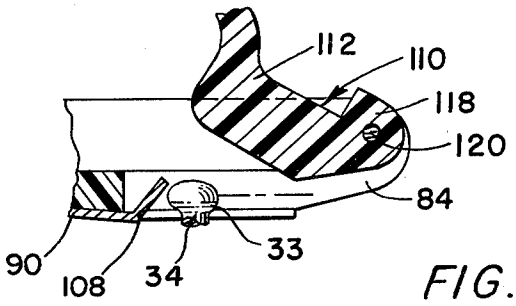


FIG. 8.

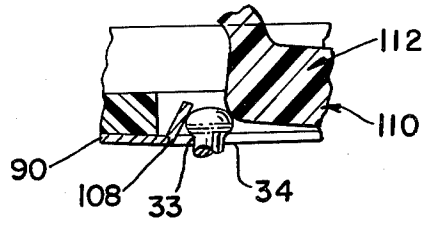


FIG. 5A.

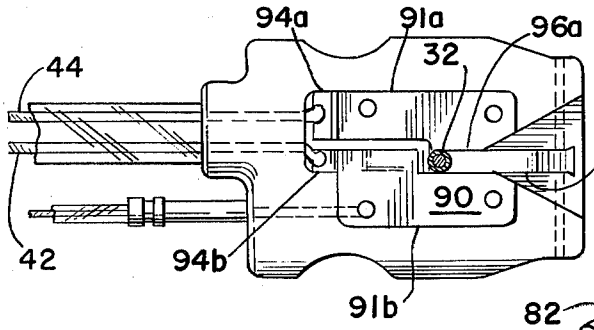


FIG. 2.

FIG. 3.

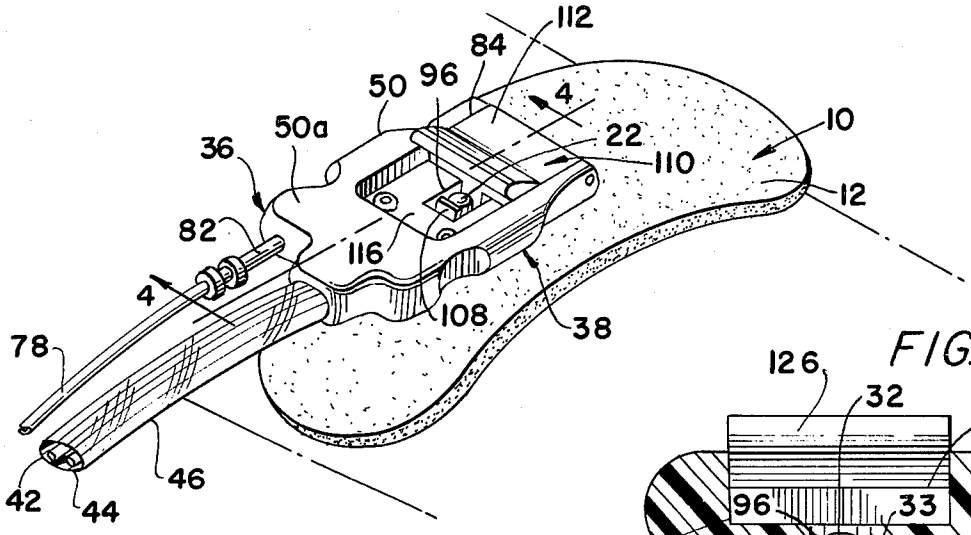


FIG. 6.

FIG. 4.

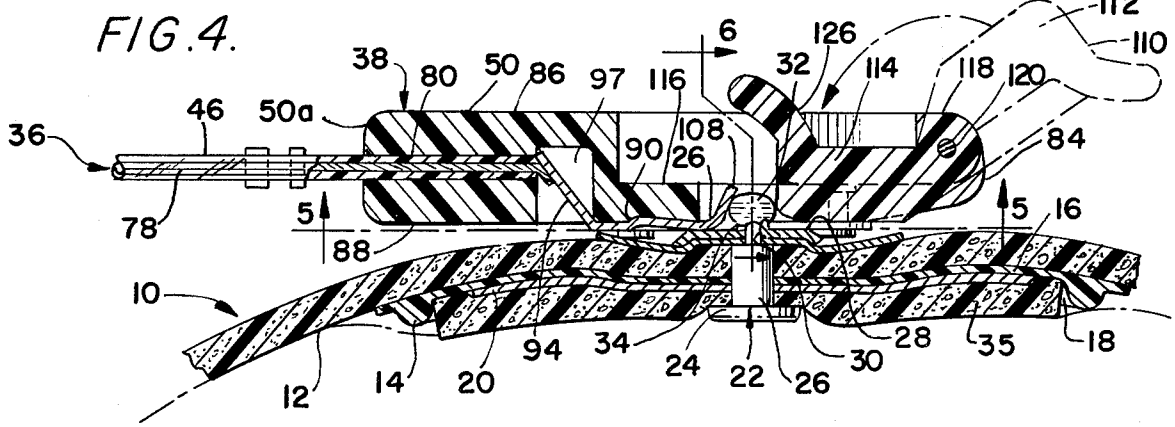
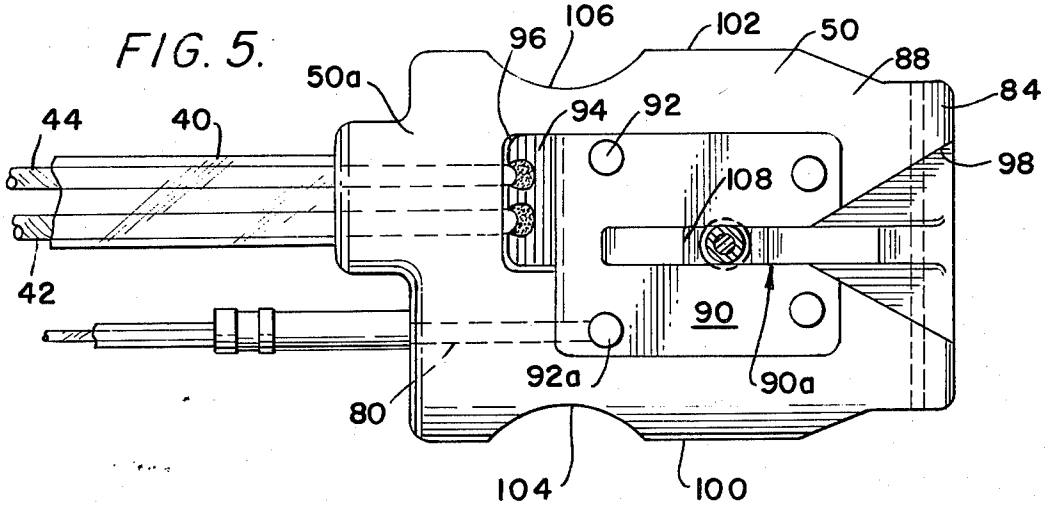


FIG. 5.



ELECTROSURGICAL GROUNDING CABLE ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally appertains to new and novel improvements in electrical connectors and is particularly directed to new and novel electrosurgical grounding cable arrangement whereby an indifferent electrode of an electrosurgical generator is connected to the ground terminal of such generator.

2. Description of the Prior Art

In electrosurgical procedures, an electrosurgical generator (E.G.) generates high frequency electric current which is fed to an active electrode used to cut tissue and coagulate blood vessels. An indifferent electrode is disposed in contact with the patient to provide a return path of the short-wave current to the E.G. which is in turn connected direct to ground or to an isolated ground unit.

The input current is applied to the tissue by means of the active electrode which is preferably of rather small cross-section so as to obtain high current densities at the surgical site. These high current densities provide the desired heating effect needed for the operating procedure. However, it is essential that the indifferent electrode be in such contact with the surface area of the tissue that the return current has a low density, thereby avoiding burning or scarring of the tissue in contact with the indifferent electrode. If the indifferent electrode or its connection to the current source is broken or faulty, the low current density is not achieved and the tissue at the point where a high current leaves will be burned or scarred.

Various factors can produce a faulty ground circuit. But one of the most common causes of faulty grounding is an improper connection of the ground wire.

In some instances, the grounding cable has a male terminal which fits into a socket on a sizeable lead plate used as the indifferent electrode and is fastened thereto by a thumbscrew. The danger in this form of contact is that the terminal of the cable may become detached from the terminal of the plate and the male end on the terminal of the cable, should it touch the patient's skin, could concentrate the whole of the current. This would produce a thermoelectrical burn.

To avoid this, the lead plate terminal in some installations is a male contact which fits into an insulated socket on the cable terminal. If such cable becomes detached from the lead plate, there would be no current flow from the plate to ground. The difficulty with such terminal connections is obvious. If this faulty situation occurs and the electrosurgical unit (E.G.) continues to generate current, there is a high possibility of patient burns, since current will seek another path to ground.

In other installations, the ground cable is permanently affixed, as by welding, to the indifferent electrode plate. In such permanent type installation, wear damage to the cable at its point of attachment occurs, and repairing of the cable is very difficult.

In any event, in known installations interrupted ground circuits due to disconnection or improper structural association of the ground cable and the indifferent electrode can occur. And such can take place at crucial times in a given surgical procedure so as to expose the patient to tissue damage and pain. And even if the patient experiences no pain or damage, nonetheless valuable operating time may be lost in effecting a repair of the ground connection. Such lost time may be critical to the electrosurgery procedure, even to the point of affecting the outcome thereof and placing the life of the patient in jeopardy.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide an electrosurgical grounding cable arrangement which obviates the drawbacks attendant with known manners of attaching ground cables to conventional patient ground plates.

The electrosurgical grounding cable arrangement of the present invention has been designed to provide the utmost in patient safety during electrosurgical procedures and is utilized with an electrosurgical grounding pad of the type and nature disclosed in U.S. applications Ser. Nos. 223,107, filed Feb. 3, 1972, now abandoned, and 328,120, filed Jan. 30. 1973, both of said applications being hereby incorporated herein by reference.

The electrosurgical grounding pad, as described in such applications, comprises an electrolyte/electrode assembly wherein the electrode and electrolyte are attached by an electrically conductive snap fastener.

The snap fastener has a stud portion that terminates in an enlarged head portion on its projecting distal end at the outer surface of the pad. The terminal head portion provides an annular shoulder on its underside.

The connector of the present invention includes an electrically conductive contact plate which is mounted on one face of a non-conductive body portion, the latter being preferably transparent so as to allow visual inspection of the contact plate and the contact points for the wiring. The body portion and the contact plate are provided with coinciding elongated trackways which slidably receive the shank of the stud. The contact plate is provided with an integrally formed tab which is disposed perpendicularly within the confines of the trackway at the terminal inner end thereof and against which the stud abuts in its fully captive position within the trackway. The tab is inherently resilient, since the contact plate is formed from thin metallic sheet material or similar electrically conductive material.

A locking lever is pivotally carried by the body portion which has a depression or cavity of an outline approximating the geometrical shape and size of the lever formed in the face opposite to the contact plate. The locking lever is pivoted on a pin arranged transversely of the trackway at the outer end thereof. The lever carries on its underside a cam that engages the stud at a point radially opposed to the tab. In the fully depressed position of the locking lever wherein it is seated in the depression in the body portion and lockingly positioned therein, the stud is securely locked between the cam and the tab. In this manner, the connector is positively locked onto the terminal stud of the indifferent electrode.

The grounding cable is preferably a double lead wire encased within a transparent and flexible sheathing formed from thermosetting or thermoplastic polymers and copolymers including nylons, polystyrene, polyvinyl chloride, acrylic resins, polyethylene, polypropylene, polyvinylidene, chloride, and other like insulating and/or engineering plastics.

According to one embodiment, the distal end of the grounding cable has a single pin jack plug provided

with two spaced contact points. One of the wires is attached to one of the contact points and the other wire is attached to the other contact point. When the terminal plug is inserted in the proper receptacle of the electrosurgical generator unit or diathermy machine, one of the contacts will be connected to the ground terminal of the machine while the other contact will be connected to a conventional monitoring system build into the machine. Such monitoring system monitors the continuity of the cable and its attachment to the indifferent electrode. In the absence of good and proper contact or cable continuity the monitoring system will activate an alarm means and/or deactivate the electrosurgical unit.

Of course, the present invention encompasses the use of a single wire cable to ground and no monitoring system. According to a preferred embodiment, the contact plate is longitudinally split or spaced apart at its terminal end forming essentially two plates or longitudinal sections only one of which carries the aforedescribed integrally formed tab. Being spaced apart, the sections are in electrical continuity only when the stud portion of the snap fastener is interposed as aforedescribed. In this embodiment, one wire of a double wire cable is attached at its proximal end to one section and the other wire, also at its proximal end, to the other section. Thus, the fastener stud and head complete the circuit, one wire leading to ground and the other wire leading to the monitoring system. Again, in the absence of good and proper contact between the plate and the fastener, or in the absence of cable continuity, the monitoring system will activate an alarm means and/or deactivate the electrosurgical unit.

Alternatively, the inner end of the contact plate may be closed forming a single essentially U-shaped plate having a tab portion, which plate may be used with one or two wires attached thereto. When, as described above, two wires are separately attached to this plate, one to ground and one to the monitoring system, only a faulty cable wire would be monitored, since the inner end of the plate completes the circuit and separation of the fastener from the plate would not be monitored.

During electrosurgical procedures, it is common to have the patient monitored by a conventional electrocardiogram machine which records the nature of the rhythmic change of certain electrical characteristics of the body which are synchronous with the heartbeat. In this way, different aspects of the phenomenon of heart action and circulation of blood in the patient are continually observed.

As an adjuvant feature of the present invention, the connector has its body portion formed with a pin jack receptacle which is attached to the contact plate alongside and along with the ends of the wires of the grounding cable. Such contact points are rearwardly of the inner end of the trackway. A terminal jack on a grounding wire is adapted to be socketed in the receptacle with the other end of the wire having a terminal jack that is inserted into the ground lead of the electrocardiogram cable.

In such fashion, the patient is hooked onto two grounds, one being the ground terminal of the diathermy machine or electrosurgical unit and the other being the ground circuit of the electrocardiogram machine. In this way, the safety of the patient is much enhanced during electrosurgical procedures. By utilizing the cable connector as a site for connecting the electrocardiogram ground lead, potential grounding hazards possible through the conventional EKG electrode should failure occur in the ground system of the electrosurgical unit are eliminated. Further, the use of the cable connector ground receptacle, instead of the typical EKG ground electrode connector, results in a reduction of monitor interference when the electrosurgical unit is in a stand-by position. The net result is a better recording of the heartbeat.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partly pictorial, partly schematic diagram illustrating the electrosurgical grounding cable assembly of the present invention in operative association with an electrosurgical grounding pad and depicting the same in use with a patient and in connective association with an electrosurgical unit and an electrocardiograph machine.

FIG. **2** is a perspective showing of the grounding cable assembly and the electrosurgical grounding pad is an unattached relation.

FIG. **3** is a perspective view of the grounding cable assembly in attachment to the grounding pad on the skin surface of a patient.

FIG. **4** is a longitudinal vertical sectional view of the connector attached to the electrode of the grounding pad and showing the locking mechanism in a full line down or locked position and in a dotted line open or unlocked position and is taken substantially on line **4—4** of FIG. **3.**

FIG. **5** is a longitudinal horizontal sectional view taken substantially on line **5—5** of FIG. **4** and showing the connector in bottom plan.

FIG. **5A** is a bottom plan view of a modified form of connector wherein the contact plate is longitudinally split into two separate longitudinal sections.

FIG. **6** is a transverse vertical sectional view, taken substantially on line **6—6** of FIG. **4.**

FIGS. **7** and **8** are fragmentary sectional views showing the locking lever in its open and closed position with respect to the protruding stud on the electrosurgical grounding pad.

Referring now more particularly to the accompanying drawings and initially to FIGS. **2** and **4** for a general understanding of the electrosurgical grounding pad assembly, which is more fully disclosed in the aforementioned patent applications, the pad **10** is composed of a substantially rectangular flexible and resilient sheet **12** carrying a substantially centrally located nonconductive cup member **14.** The cup member has a flat base **16** superimposed on one side or face of the sheet. And the cup member has a cavity **18** opening to the body surface of the patient. Within the cavity and resting on the interior surface of the base **16** is a flexible sheet **20** of conductive metal electrode. The diameter of the cup member **14** is substantially greater than its height, thus providing a low profile.

The flexible and resilient sheet **12,** the cup member **14** and the flexible sheet **20** of conductive metal are held together by an electrically conductive stud fastener **22.** The fastener includes an inner annular plate **24** from the center of which a hollow shank **26** projects outwardly and an outer plate **28** having a hollow socket portion **30** receiving the shank **26.**

The parts are assembled and held together by centrally locating and aligning the cup member **14** containing the likewise centrally located and aligned flexible

sheet **20** of conductive metal and the outer plate **28** with its hollow socket portion **30** on opposite sides of the sheet **12.** The shank **26** is inserted through aligned apertures in the centers of the flexible conductive sheet **20,** the base **16** and the resilient sheet **12** and is socketed in the socket **30.** By pressing together such portions of the stud, the upper part of the stud **22** is crimped inwardly and its side walls collapse outwardly whereupon the parts are tightly wedged together. In so doing, the stud, composed of the sheet portion **30** and the shank **26,** is formed with an outer rounded and enlarged head or distal end portion **32** that, due to its enlargement in relation to the shank port of the stud, has an annular groove **34** (cf. FIG. **7**) formed below the distal end and defining an annular locking shoulder **33.**

The electrolyte is preassembled with the electrode **10** by soaking a disc-shaped sponge-like cellular matrix **35** of non-conductive, open-cell material with an electrode jelly. The sponge-like matrix **35** preferably has a diameter equal to the diameter of the base **16** of the cup member **14** and a thickness greater than the depth of the cup member **14,** as can be appreciated from a consideration of FIG. **4.** It is sufficiently heavily laden with electrode jelly that, when the electrode **10** is pressed on the skin surface of the patient, the jelly fills the entire volume of the cavity between the skin surface and the conductive metal sheet **20** and plate portion **28** whereupon good electrical contact between the skin and the conductive metal sheet electrode **20** and the connective stud **22** is assured.

As diagrammatically and pictorially depicted in FIG. **1,** the electrosurgical grounding pad **10** is applied on the arm of the patient P and, because of the nature of the pad, it is easily contoured to the curved skin surface. Obviously, the pad can be applied to the patient in any area selected by the surgeon. But it is preferred that the area be a curved skin surface, such as a thigh or arm easily accessible for attachment of the electrosurgical grounding cable assembly **36,** as shown in FIG. **1.** The pad is applied by pulling it taut just as in the manner of applying a bandage.

The electrosurgical grounding cable assembly **36** is generally composed of a connector **38** which is lockingly attached to the head portion **32** of the stud **22** by being slidably engaged within the groove **34,** as shown in FIG. **4.** The connector **38** has one end of a cable **40** attached thereto, as will be described, so as to be in electrically conductive relation with the stud **22** and thereby with the indifferent electrode **20.** The grounding cable **40** is composed of two lead wires **42** and **44** that are housed in a transparent insulative sheathing or covering **46.** The sheathing or covering **46** is flexible and preferably transparent so that a quick visual inspection can be made for any breakage or damage of the lead wires **42** and **44** housed therein. The sheathing is formed from non-conductive transparent materials, such as thermosetting or thermoplastic polymers and copolymers of various types, e.g., polyethylene, polypropylene, or like insulating plastics.

The grounding cable **36** terminates in a single pin jack plug **48** which also has a non-conductive body portion of, preferably, transparent material. The plug and the body portion **50** of the connector are solid and may be molded or otherwise formed from thermosetting or thermoplastic polymers and copolymers including nylons; polyethers, such as oxymethylene polymers and copolymers; polystyrene; ABS; polyvinyl chloride; polymethacrylate; polymethylmethacrylate and polyacrylonitrile, copolymers thereof and other like acrylic resins; polyethylene; polypropylene; polyvinylidene chloride; polysulfones; polycarbonates; and other like insulating and engineering plastics.

The electrosurgical generator or unit **52** has an active electrode **54** which is connected by a lead **56** provided with a switch **58,** preferably a foot switch, to the output circuit system of the electrosurgical unit **52.** Such a unit is conventional and, in general, comprises a high frequency current generating system including a R.F. oscillator which drives a gain controlled power amplifier that is coupled via a step-up transformer and coupling capacitors to the active electrode **54.** The unit has a suitable receptacle **60** in which the terminal plug **48** is inserted.

The grounding cable **40** is a twin lead wire cable with the jack plug **48** being a common plug for both lead wires. The plug has two spaced apart electrodes or contact points **62** and **64.** Thus, when the plug **48** is inserted in the receptacle **60** in the electrosurgical unit or diathermy machine **52,** as shown schematically in FIG. **1,** the lead wire **42** of the grounding cable is carried to the ground terminal **66** while the other lead wire is carried to a monitoring device **68.**

The monitoring device is of conventional construction and functions either to sound an alarm and/or deactivate the electrosurgical unit. Generally speaking, the monitoring device has a solenoid and the lead wire **44** in the grounding cable **40** establishes a continuous circuit from the electrosurgical unit **52** to the indifferent electrode and back again which holds open the solenoid. As soon as this circuit is broken, as above described, e.g., by the connector **38** becoming somehow impaired or loosened from the stud **22** of the indifferent electrode **20,** when using a split contact plate, the circuit is broken, the solenoid closes and the monitoring device **58** initiates its alarm and/or deactivating action.

However, it is obvious, as far as the present invention is concerned, and as previously pointed out, that the cable **36** can be a single wire cable which merely is a grounding wire. The other wire **44** can be eliminated if the machine **56** does not possess the conventional monitoring device or system.

As shown in FIG. **1,** the patient P is connected via unipolar limb leads **70** and **72** to the central terminal **74** of a conventional electrocardiograph machine **76.** The machine is provided with the usual three-prong plug, one prong of which constitutes the ground.

As is well known, the conventional electrocardiograph machine, such as the machine **76** in FIG. **1,** is provided with the usual central terminal connection **74** from which a series of electrical leads extend. Ordinarily, at least four such leads extend from the central terminal connection **74** to the arms and legs of the patient. There is also a second terminal, commonly referred to as the exploring terminal, from which an exploratory lead extends, this lead being designed for successive application by the operator of the machine to various portions of the chest.

However, for purposes of its use in electrosurgical procedures, it is common to use three EKG electrodes, one of which is used as a ground connection to the EKG monitor. In accordance with the present invention, an interconnecting wire **78** is connected between the EKG **76** and the connector **38** so as to eliminate the

need for the conventional EKG ground electrode. In this respect, as shown in FIG. 2, the end portion 50*a* of the body 50 of the connector 38 is provided with a female socket or receptacle 80 in which the jack plug 82 of the interconnecting wire 78 is socketed. The wire has a similar jack plug 83 provided on its opposing end and such jack plug fits in the central terminal connection 74 (FIG. 1). In this manner, the EKG and the electrosurgical unit are groundingly interconnected.

By virtue of the interconnecting wire 78, the patient is provided with two ground sources, one the EKG 76 and the other the diathermy machine or electrosurgical unit 52. By utilizing the interconnecting common grounding wire 78, further advantages can be obtained. One advantage is a reduction of monitor interference when the electrical surgical unit is in a stand-by position. Another advantage is the elimination of potential grounding hazards possible through the conventional EKG electrode should failure occur in the electrosurgical ground unit. Another advantage resides in the elimination of the conventional EKG ground electrode.

The connector 38, as shown more particularly in FIGS. 3–8, includes the body portion 50, which is solid and which is molded or otherwise formed from the various plastics materials, as aforedelineated. Preferably, the body portion is formed from clear material as is the terminal plug 48 and the casing or sheathing 46 of the grounding cable 36. Such transparency is desirable since it permits the operator, prior to use, to visually inspect the entire grounding cable assembly for any obvious breakage or damage.

The body portion 50 has a rear end portion 50*a* in which one end of the cable with its enclosed lead wires is inserted. Such end portion 50*a* houses the jack receptacle 80 for the interconnecting grounding wire 78. The body has a front end portion 84 and it has a top side or face 86 and a bottom side or face 88.

A contact plate 90, formed of metal or other conductive thin sheet material, is securely superimposed on the bottom face 88 by rivets 92 or similar fastening means. The contact plate 90 has a rear lip portion 94 which is bent upwardly and fits within a groove 97 formed in the underside of the rear end portion 50*a* of the body 50. The lead wires 42 and 44 of the cable 40 are attached by solder or the like to the lip portion 94, as shown in FIG. 5. The receptacle or socket 80 for the interconnecting wire jack 82 is soldered to the rivet 92*a* of the contact plate, as shown in FIG. 5. In any event, the receptacle or socket 80 and the lead wires are in good electrical contact with the contact plate. All of such contact points are visible through the upper face of the body portion.

The body 50 is formed with an elongate slot 96 that defines a trackway and that passes through the front end portion 84, as shown in FIGS. 4, 5 and 6. The trackway is rectangular and of a width just slightly greater than the diameter of the stud 22 at its grooved portion 34 so that the opposing straight side edges 96*a* and 96*b* of the trackway slide in the groove, without undue lateral play and dispose the body portion beneath the shoulder 33. As the trackway opens through the forward end, the side edges diverge outwardly so that the open front end of the trackway is defined by a divergent throat portion 98 which serves to guide the trackway onto the stud. In this respect, the opposing side edges 100 and 102 of the body portion 50 are formed with recessed finger gripping areas 104 and 106 whereby the body can be manually manipulated.

The contact plate 90 is provided with a tab 108 which extends upwardly therefrom and which is disposed perpendicularly wthin the trackway at the inner edge thereof so that it confronts the inner lateral end wall of the trackway. The tab is of a width commensurate with the width of the trackway and is positioned at the inner end thereof so that it will be engaged by the head of the stud 22 in the manner shown in FIG. 4. This will insure good electrical contact between the stud extending from the electrode 20 and the ground cable.

FIG. 5A differs from FIG. 5 in that the contact plate 90 is split longitudinally at its inner end providing separate longitudinal plate sections 91(*a*) and 91(*b*) and lip portions 94(*a*) 94(*b*) extending from said sections, the split providing opposed, parallel edge extensions of trackway straight side edges 96(*a*) and 96(*b*). Cable lead wires 44 and 42 are attached to lip portions 94(*a*) and 94(*b*), respectively. Interposed fastener head portion 32 and shoulder 33 (FIG. 6) provide the electrical continuity between both sections. Obviously, removal of the fastener would interrupt the continuity.

In order to insure that such electrical contact is maintained and to lock the connector onto the stud, a locking means 110 is provided adjacent the outer or open end of the trackway 96 and at the front end portion 84 of the connector body 50. Such locking means includes a pivoted lever 112 formed of non-conductive material and preferably formed of the same clear material as the body 50 of the connector. The lever has a flat body portion 114 and the top wall 86 of the connector body 50 is formed with a cavity or depression 116 of a size and shape approximating the geometrical shape and size of the body of the lever. The lever body is adapted to seat in such depression or cavity, as shown in FIGS. 3 and 4. The lever body has a tail end portion 118 which is mounted on a pivot pin 120 that is fixed transversely between the opposing side walls of the depression at the forward end portion 84 of the body. The pivot pin is positioned, as can be seen from FIG. 4, in a plane above the plane of the bottom wall of the depression so that the body portion 112 of the lever seats on the bottom wall and is disposed below the pivot axis so as to be locked in its seated position.

The lever body, as can be seen in FIGS. 2 and 4, has an integral cam bar 122 formed on its underside and providing a cam surface 124 which is adapted to engage the head 32 of the stud 22, as shown in FIG. 4 so as to clampingly hold the head tightly against the contact tab 108. Thus, when the lever is in its down or seated position, the cam engages the head to lock the connector onto the stud. The bar is of a width to fit in the trackway behind the pin 22.

The lever has a free end which is provided with an angular lip 126 which extends upwardly and forwardly when the lever is in its seated position, as shown in FIG. 4. In such position, the lip projects above the top surface of the wall of the connector body 50. The lip serves as a finger gripping means so as to move the lever upwardly and downwardly about its pivot axis.

For the purpose of locating the cable 36 and the interconnecting grounding wire 78 so as to hold them out of any conflicting position, with respect to the patient, surgeon, and other operating room attendants, a clamping means 128 is provided, as shown in FIG. 2. The clamping means includes a bar 130, having a guide

arrangement **132** through which the cable and wire are passed. The bar terminates in an alligator clip **134** that can be attached to a patient covering sheet or other holding means readily accessible to the operating table.

In use, the first step that must be taken is to visually inspect the connector **38** by locking through the transparent body **50** so as to inspect the contacts for the interconnecting grounding wire **78.** The wires **42** and **44** should be visually inspected as should the contacts in the terminal plug **48.** Since the terminal plug **48** and the body portion **50** of the connector are formed from a clear material, such visual inspection can be readily carried out. Also, due to the transparency of the sheating **46** for the cable, the continuity of the wires **42** and **44** can be easily visually determined.

The next step requires the insertion of the plug **48** into the proper receptacle **60** in the electrosurgical generator **52.** Prior to this, the electrosurgical grounding pad **10** has been wrapped around the arm of the patient P, as shown in FIG. **1.** The operator then grasps the body of the connector **38** with the thumb and middle finger of one hand being disposed in the recessed or cut-out areas **104** and **106** on the sides of the connector. The connector is held and slidably placed over the head **32** of the stud **22** so that the trackway slides in the groove **34.** In this respect, it is to be noted from FIGS. **5** and **5A** that the contact plate **90** has a trackway **90***a* formed therein complemental to and underlying the trackway in the body portion. However, the side edges of the trackway **90***a* in contact plate **90** protrude inwardly of the sides of the trackway in the body **50** of the connector. Thus, the stud will engage the side edges **96***a* of the trackway in the contact plate. This is easily determined by visual inspection.

The body is slid over the stud until the contact tab **108** abuts the stud **22.** At this point, the locking lever **112** is pressed downwardly with the forefinger while holding the connector body between the thumb and middle finger. A positive snapping action takes place and the connector is locked onto the stud.

While the connector **38** is especially designed for use in the disclosed electrosurgical environment, it can be appreciated that the same possesses utility for use in other akin or dissimilar environments.

Thus, in this respect and in regard to the other details of the inventive concept, as herein disclosed, it is to be understood that such specific disclosure is merely exemplary. And the inventive concept is only to be interpreted in accordance with the terms and scope of the appended claims.

What is claimed is:

1. For use with electrosurgical equipment including (a) an electrosurgical generator for generating high frequency electric current, (b) an active electrode electrically connected to said generator and used to cut tissue and coagulate blood, and (c) an indifferent electrode for attaching to a patient an electrical ground means, a grounding assembly suitable for said electrosurgical equipment and comprising, in combination, a connector and a cable, said connector, in turn, comprising a body provided with a slot defining an open trackway along a face of said body for receiving, on one end of the trackway, a conductor electrically coupled to said indifferent electrode, and means at the opposite end of the trackway for terminating the trackway while still retaining said conductor on said trackway, an electrically conductive contact means, carried by said body, electrically coupled with said conductor on said trackway, while said conductor is in said trackway, and with one end of the cable, the opposite end of said cable being electrically coupled to ground, and locking means carried by said connector and positionable in said trackway to lock said conductor in electrical contact with said contact means.

2. The invention of claim **1,** wherein said connector has a non-conductive solid body.

3. The invention of claim **2,** wherein said conductor electrically coupled to said indifferent electrode is a projecting stud over which the trackway slides and said stud is formed with a groove in which the trackway moves.

4. The invention of claim **3** wherein said contact means includes a resilient tab of conductive material arranged generally perpendicularly of the trackway and providing said means at one end of the trackway to terminate travel of the latter along the conductor.

5. The invention of claim **4,** wherein said locking means includes a lever formed from non-conductive material, a pivot pin arranged transversely of the trackway adjacent the open end thereof, said lever having one end mounted on the pivot pin for swinging movement about an axis normal to the trackway and said lever having an opposing free end portion having a cam surface releasably engaging the stud in clamping relation with the tab.

6. The invention of claim **5,** wherein said connector body has opposing top and bottom faces, said opening of said trackway being in said bottom face of said body, said contact means including a plate portion fixed on the bottom face and from which the tab upstands in the trackway, said connector body having opposing ends and the trackway being elongated and passing through one end of the body and said pivot pin being disposed and passing through one end of the body and said pivot being disposed at said end.

7. The invention of claim **6,** wherein said plate portion is longitudinally split to effect two plate sections and the resilient contact tab upstands in the trackway from one of said sections and arrests the inward movement of the stud along the trackway.

8. The invention of claim **7** wherein said top face of the connector body has a depression of a size and shape approximating the size and shape of the lever which is seated therein, said depression, in turn, having an opening in the bottom thereof in communication with said trackway having said stud upstanding therein, the opening being of a size and shape approximating the size and shape of the cam surface releasably engaging the stud in clamping relation with said tab, and said pivot pin is in a plane above the plane of the bottom of the depression with said lever being disposed below the pivot pin plane when it is seated in the depression so that it is below its pivot axis and is locked in place in the depression.

9. The invention of claim **8** wherein said locking lever has an angular lip on its free end, said lip projecting upwardly from the lever in its seated and locked position and defining a finger piece.

10. The invention of claim **9** wherein said connector body is transparent.

11. The invention of claim **9** wherein said cable whose proximal end is attached to said connector comprises lead wire encased in transparent plastic for visual inspection of the lead wire, and, at the distal end of the

cable, a transparent terminal plug for visual inspection of the contact means by which the distal end of said lead wire is attached.

12. The invention of claim **1** wherein said electrosurgical equipment includes an electrocardiograph machine having a monitoring patient cable ground circuit and said connector is provided with a receptacle in contact with the contact means, a grounding wire having opposing jack plug ends, one of said jack plug ends being attached to the ground jack of the electrocardiograph machine and the other jack plug end being insertable in the receptacle in the connector body.

13. A cable grounding assembly for use with an electrosurgical grounding pad having a patient contacting inner surface and an outer surface from which a stud projects having an annular groove, said assembly comprising a connector having a solid non-conductive body portion having opposing top and bottom faces, and formed in the bottom of said faces is a slot-like, elongated trackway which slides over the stud and in the groove, said trackway having an outer end and an at least partially closed inner end, an electrically conductive contact plate fixed to the bottom face and having an integral inherently resilient tab projecting therefrom and disposed in the trackway at the inner end thereof and which bears against the stud, a locking lever of non-conductive material pivotally mounted on the connector body adjacent the outer end and means for locking the lever in clamping relation with the stud so as to lock the latter against the contact tab to prevent motions transverse to and parallel to said trackway and a grounding cable extending from the connector body in contact with the contact plate and having a distal end provided with a terminal plug adapted to be inserted in an electrosurgical unit.

14. The invention of claim **13** wherein said locking means includes said top face of the connector body being formed with a depression of a size and shape to receive the lever and a pivot pin for the lever arranged in the connector body transversely of the trackway at the open end thereof and disposed in a plane above the bottom of the depression so that the major part of the lever is below the pivot axis when seated in the depression.

15. The invention of claim **14,** wherein said lever has a free end provided with an angular lip that upstands therefrom when the lever is seated in the depression and extends above the top face of the connector body.

16. The invention of claim **13,** wherein said connector body, grounding cable and terminal plug are transparent.

17. The invention of claim **16** wherein the connector body, the cable and the terminal are formed from transparent polymeric materials.

18. A grounding assembly suitable for use with electrosurgical equipment and comprising, in combination, a connector and a cable, said connector, in turn, comprising a body provided with a slot defining an open trackway along a face of said body for receiving on one open end of the trackway, a conductor and means at the opposite end of the trackway for terminating the trackway while still retaining said conductor on said trackway, an electrically conductive contact means, carried by said body, electrically coupled with said conductor on said trackway, while said conductor is in said trackway, and with one end of the cable, the opposite end of said cable being electrically coupled to ground, and locking means carried by said connector and positionable in said trackway to lock said conductor in electrical contact with said contact means.

19. The invention of claim **18** wherein said conductor is a stud having an annular groove in which the trackway slides.

20. The invention of claim **18** wherein said connector body has a bottom face and a top face and said contact means further includes a thin plate fixedly superimposed on the bottom face and having a trackway complementing the body trackway but of slightly less width than the body trackway so that the bounding walls of the contact plate trackway engage the conductor.

21. The invention of claim **18** wherein said connector body has a top face formed with a surface cavity and said locking means includes a locking lever, a pivot pin mounted in the connector body adjacent the open end of the trackway and arranged transversely thereof, said lever having one end pivoted on said pin and having a cam means on its other end releasably engaging the conductor, with said lever being sealed in the cavity and bearing against the conductor.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,895,635

DATED : July 22, 1975

INVENTOR(S) : George Junior Justus et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 21, change "is" to --in--.

Column 4, line 40, change "position" to --positions--.

Column 5, line 10, change "sheet" to read --socket--.

Column 9, line 62, after "one" insert --open--.

Column 10, line 37, delete entire line.

Column 10, line 38, delete "being disposed".

Signed and Sealed this

sixteenth Day of *December 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks