

Bolduc

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- [21] Appl. No.: 145,164

[58] **Field of Search.**128/404, 416, 418, 410, 303.13;
339/75

1,498,059	6/1924	Tyler	128/416
1,662,446	3/1928	Wappler	128/416
1,967,815	7/1934	Friberg	128/416 X

[57] **ABSTRACT**

17 Claims, 10 Drawing Figures

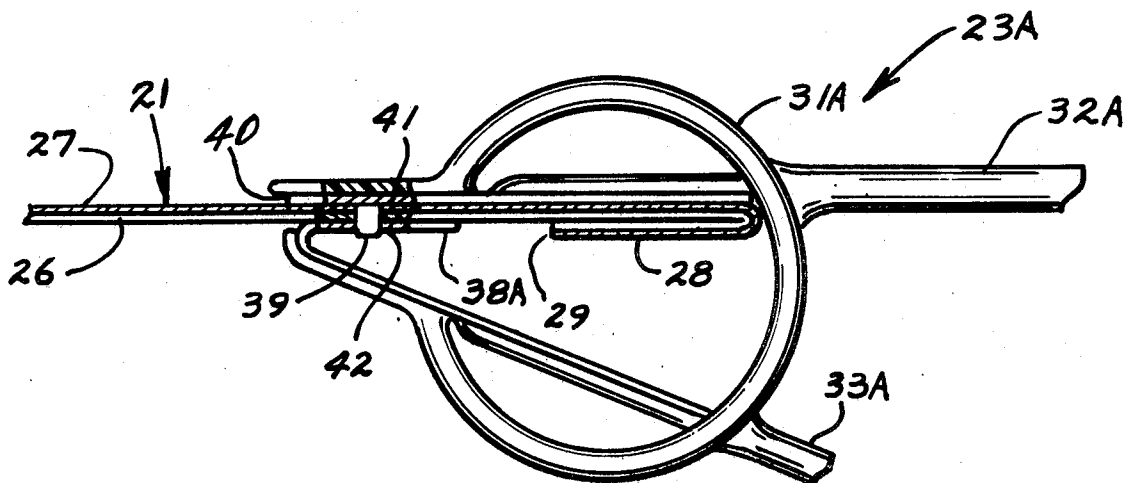


FIG. 1

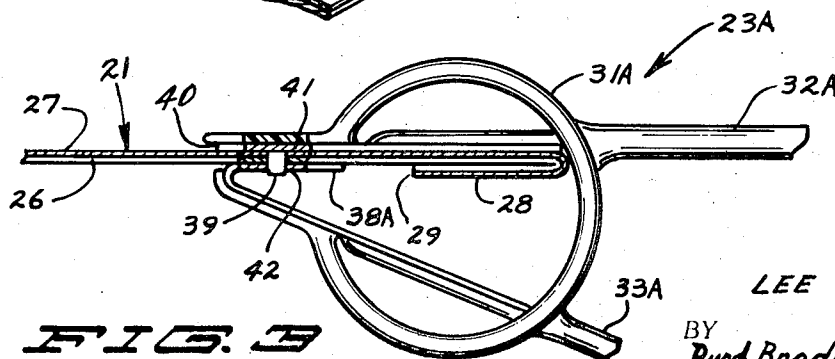
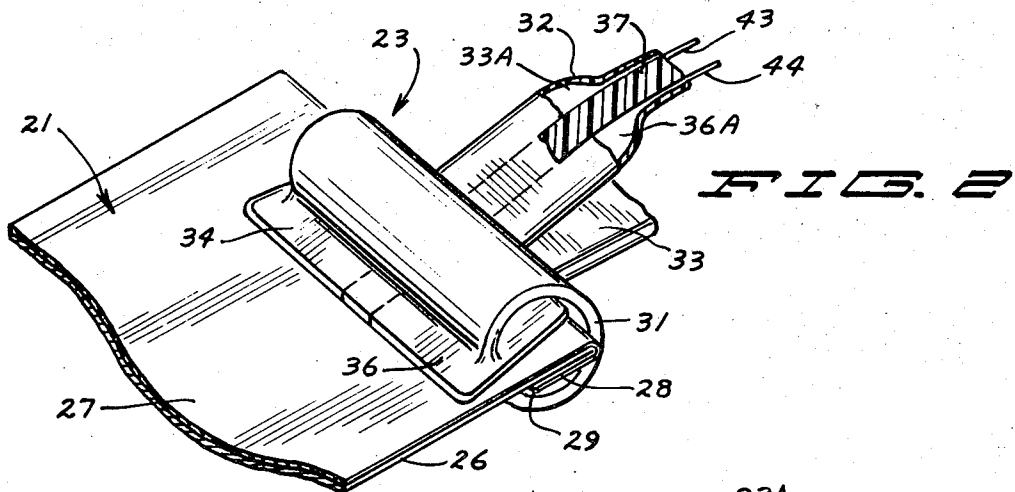
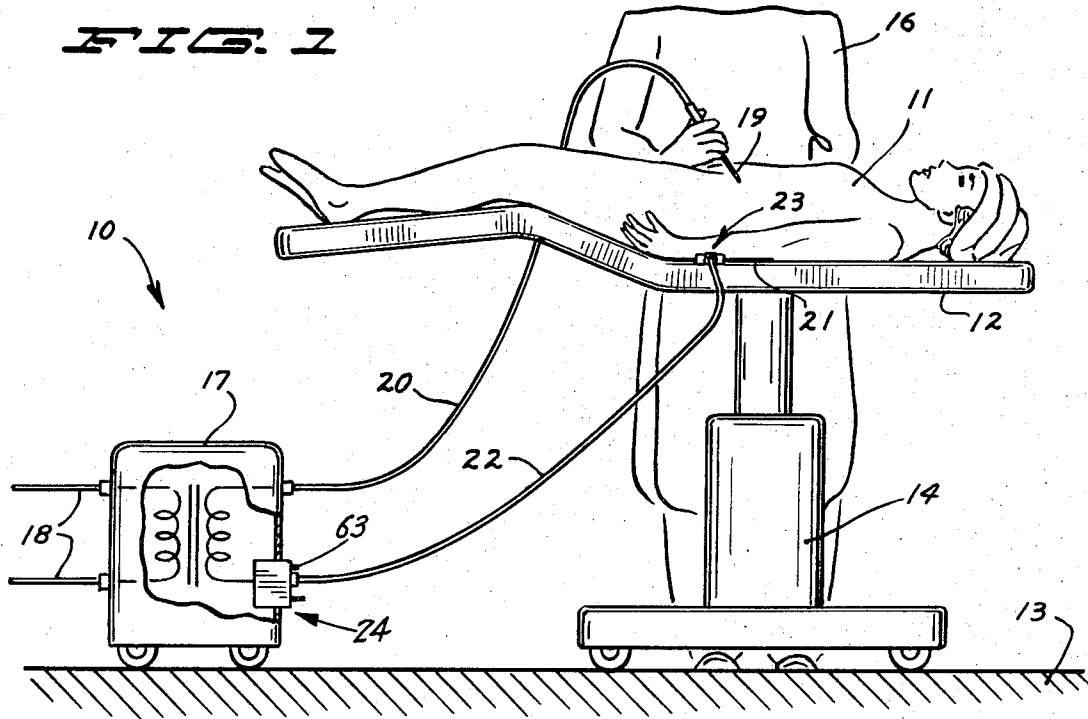
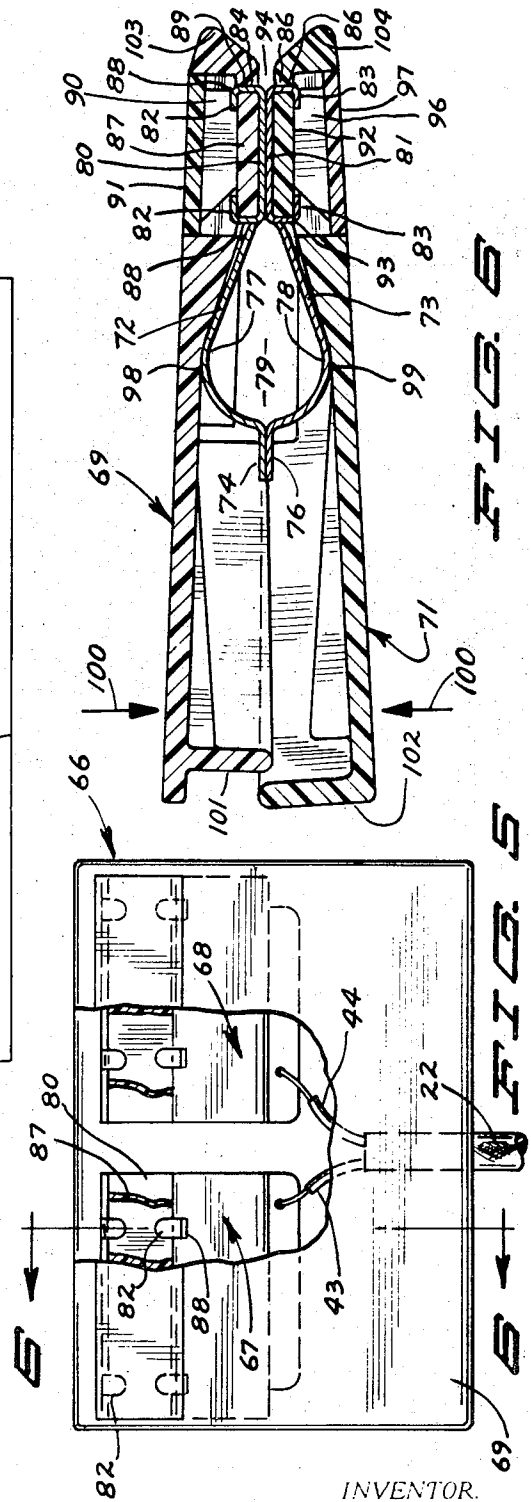
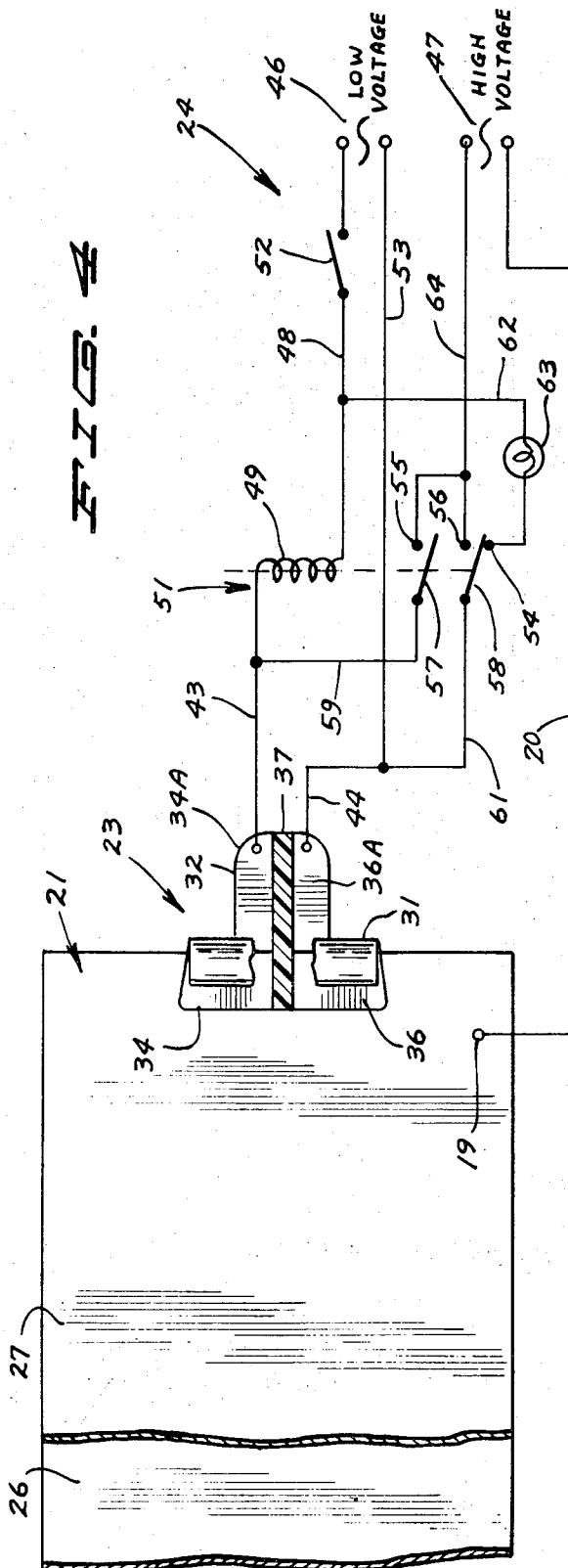


FIG. 3

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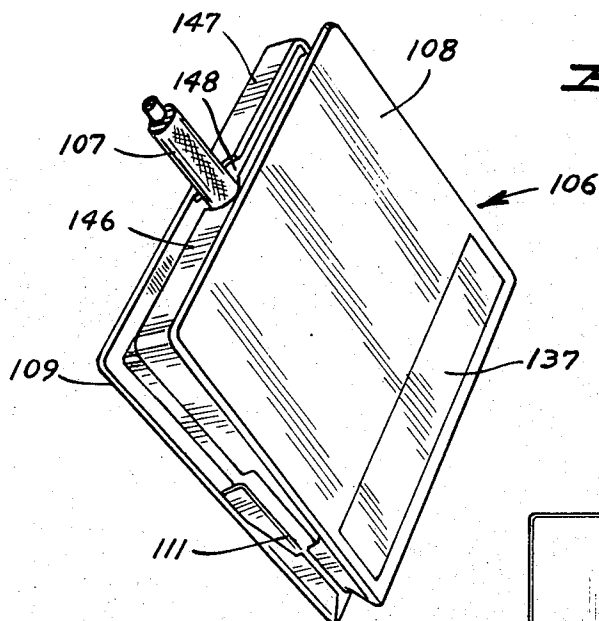


FIG. 7

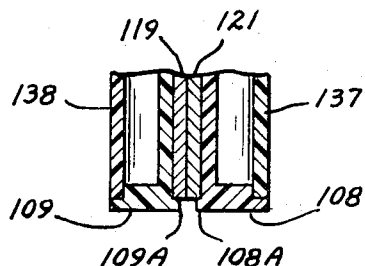


FIG. 10

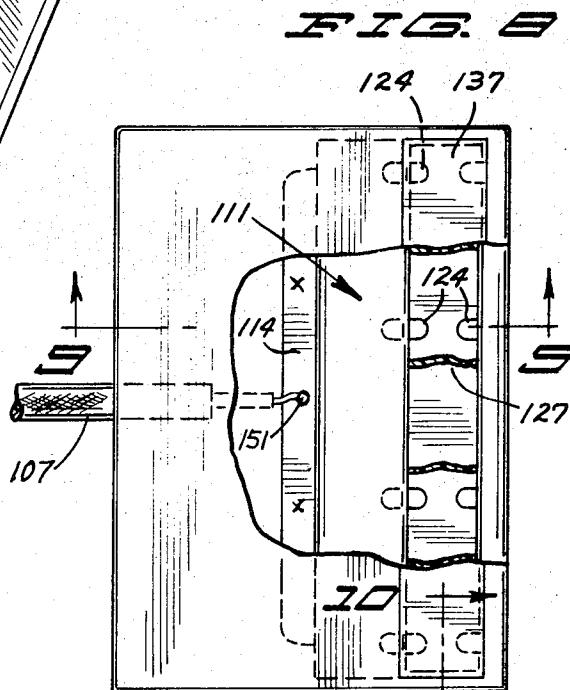


FIG. 8

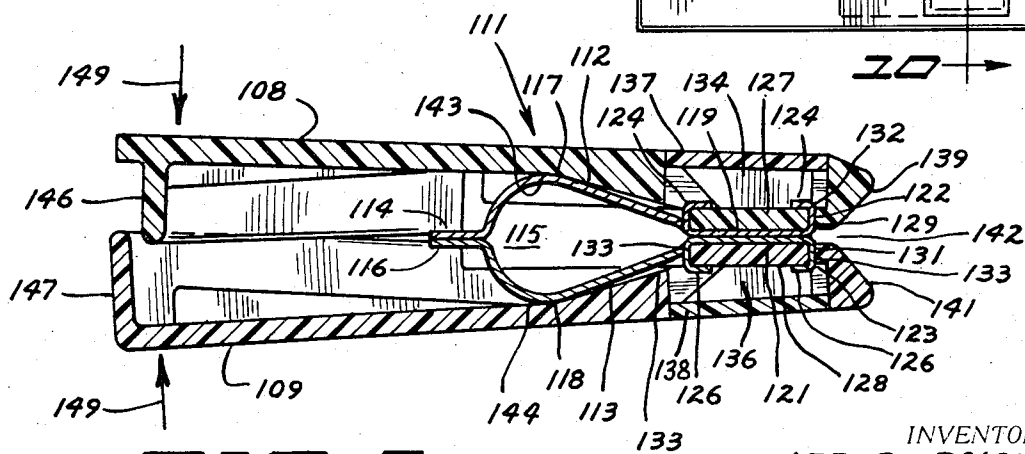


FIG. 9

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ELECTRICAL CONNECTOR AND PLATE ELECTRODE

CROSS REFERENCE TO RELATED APPLICATION

This application is a division of U.S. patent application Ser. No. 762,582 filed Sept. 25, 1968, now U.S. Pat. No. 3,624,590.

BACKGROUND OF INVENTION

U.S. Pat. No. 3,543,760 describes a disposable ground electrode and connector usable in an electrosurgical unit for cautery, fulguration, electrocoagulation and the like. The connector has an electrical contact plate engageable with the skin of the ground electrode to provide surface electrical contact between the connector and the ground electrode.

One edge of the electrode has a turned flange which cooperates with the connector to prevent accidental separation of the connector from the electrode.

Electrical hazards in the medical field, particularly in the hospital environment, have caused serious harm to patients. The improper grounding of a patient on which electrosurgical procedures are used can cause severe burns. This hazard can be substantially reduced by having a substantial surface contact between the patient and the ground electrode, a good electrical connection between the electrical connector and ground plate electrode, and holding structure on the connector and electrode which work together to prevent accidental separation of the connector from the electrode.

SUMMARY OF INVENTION

The invention is directed to a connector in combination with a ground plate electrode designed for use in electrosurgical machines for cautery, fulguration, electrocoagulation and like operating procedures. The ground plate electrode has an electrically conductive skin of a size so that substantial surface electrical contact is achieved between the electrically conductive skin and the patient. The electrode is a one-piece flexible sheet member having a non-electrically conductive base. The skin means covers substantially one side of the base and is secured thereto. The connector has a coating or lock means cooperating with the plate electrode to hold the connector in assembled relation with the plate electrode so that it cannot be accidentally removed from the plate electrode when the connector is attached to the plate electrode. The connector is releasably attached to the plate electrode so that the electrode can be removed and the connector used with a new disposable electrode. In one form, the connector has structure adjacent the conductor extended at an angle relative to the plane of the conductor to cooperate with a portion of the electrode to positively hold the connector in assembled relationship with the plate electrode. This portion of the structure is a projection or finger which extends through a hole in the electrode. In the drawings

FIG. 1 is a diagrammatic view of the electrical-surgical unit equipped with the ground plate electrode and connector of the invention used on a patient lying on an operating table;

FIG. 2 is a perspective view of the releasable connector attached to an edge of the ground plate electrode;

FIG. 3 is a side view of one form of the connector of FIG. 2, partly sectioned, in assembled relation with a ground plate electrode;

FIG. 4 is an electrical diagram of the test and control circuit;

FIG. 5 is a plan view, with parts broken away, of another form of the connector;

FIG. 6 is an enlarged sectional view taken along the line 6—6 of FIG. 5;

FIG. 7 is a perspective view of a further form of the connector;

FIG. 8 is a plan view of the connector of FIG. 7 partly broken away to illustrate the contact plates;

FIG. 9 is an enlarged sectional view taken along the line 9—9 of FIG. 8; and

FIG. 10 is an enlarged sectional view taken along the line 10—10 of FIG. 8.

Referring to the drawings, there is shown in FIG. 1 and electrosurgical unit indicated generally at 10 illustrated in operating environment on a patient 11 lying on a table 12. Table 12 is supported on floor 13 by an upright base 14 to locate the patient in a convenient position for the surgeon 16.

The electrosurgical unit 10 uses high frequency current from a portable transformer 17 connected to power supply lines 18 and to an active electrode 19 by a cable or line 20. The circuit through the patient 11 is completed with a ground plate electrode 21 located in contact with an area of the skin of the patient. A line or cable 22 connected to the electrode 21 through a releasable connector, indicated generally at 23, clamped to the ground plate electrode 21 completes the circuit to the transformer. The opposite end of line 22 is connected to a test and control circuit indicated generally at 24 carried by the transformer 17. In use, the surgeon 16, prior to operative use of the active electrode 19, will visually observe a light 63 on the test and control circuit to see if the releasable connector 23 is in electrical contact with the ground plate electrode 21 and determine if high voltage is present in the operating circuit.

Referring to FIGS. 2 and 4, there is shown the disposable ground plate electrode 21 as having a flat base 26 covered with an electrically conductive skin 27. Plate 21 has an end flange or flap 28 folded over forming a stop edge 29. The base can be impregnated with a plastic material which bonds the skin 27 to the top of the base. The skin is an electrically conductive material, as sheet metal or aluminum foil. The ground plate electrode 21 is described in detail in U.S. Pat. No. 3,543,760.

The releasable connector 23 functions to provide an electrical connection between the cable 22 and the ground plate electrode 21. Connector 23, shown in FIGS. 2 and 4, has a C-clamp 31 pivotally carrying a pair of angularly disposed levers 32 and 33. As shown in FIG. 2, lever 32 has separated contact plates 34 and 36 and rearwardly directed conductor arms 34A and 36A separated with plastic or other non-electrically conductive material 37. Lever 33 may have similar separated plates formed with a rearwardly directed lip 38A to hold the contact plates 34 and 36 in flat surface engagement with the electrically conductive skin 27 of the ground plate electrode 21.

Referring to FIG. 3, there is shown a modified conductor 23A having a plate 40 carrying a downwardly directed projection or finger 39 extended through a hole 41 in plate 21 and hole 42 in the lip 38A. The other contact plate may also have a similar projection or finger located in aligned holes in plate 21 and the separated lip. The projections positively lock the releasable connector 23A to the ground plate electrode 21 so that it cannot be accidentally removed or partially separated from the plate electrode 21.

The entire C-clamp and exposed portions of the levers 32 and 33 are coated with a plastic insulative material so that the connector cannot short out the ground plate electrode 21, causing burning of the patient. The lines 43 and 44 from the cable 22 are connected to the terminal portions of the conductors 34A and 36A respectively, as shown in FIG. 2.

Referring to FIG. 4, there is shown connector 23 in assembled relation with the ground plate electrode 21 along with the test and control circuit 24. The transformer 17 provides the circuit 24 with a low voltage source 46 and a high voltage source 47. Line 48 connects a coil 49 of a relay 51 to the low voltage source 46. The coil 49 is connected to line 43 leading to the conductor arm 34A. A manually operated control switch 52 interposed in the line 48 between the coil 49 and the low voltage source 46 controls the circuit for the low test voltage and the circuit for the high voltage. The low voltage circuit is completed with a line 53 connected to the line 44 leading to the opposite conductor arm 36A of the connector 23. Relay 51 has three contacts 54, 55 and 56 and a pair of movable switching elements 57 and 58 operably associated with the coil 49. Switching element 57 is connected with a line 59 to the line 43. Switching element 58 is connected with a line 61 to the line 44. The contact 54 is connected to a line 62 which leads to the low voltage line 48. A light 63 is interposed in the line 62 to indicate an improper or insulated electrical connection between the connector 23 and the ground plate electrode 21. The light 63 may be replaced with an electrically operated sound producing device or other signal means to provide a sensing signal indicating a defective electrical connection between the connector 23 and the ground plate electrode 21. Both contacts 55 and 56 are connected to the high voltage line 64 to complete one line of the high voltage circuit. The high voltage circuit is completed through the patient 11, the ground plate electrode 21 and line 20.

In use, the switch 52 is closed connecting the high voltage source 46 to the connector 23. With the relay 51 in its normal position, the switching elements 57 and 58 are out of engagement with the contacts 55 and 56. The element 58 engages contact 54 closing the circuit to the light 63. When the light 63 is "on," there is a non-electrical contact between the connector 23 and the electrode 21 in that current does not flow via the ground plate electrode 21 between contact plates 34 and 36. When the connector 23 is in proper electrical contact with the electrode 21, the low voltage circuit is completed through the plates 34 and 36 via the electrically conductive skin 27 to energize the coil 49. This moves the switching elements 57 and 58 into engagement with the contacts 55 and 56 thereby opening the circuit to the light 63 and closing the high voltage circuit to the connector 23. Both contact plates 34 and 36

are connected in the high voltage circuit by virtue of the two switching elements 57 and 58. The high voltage circuit is completed through the active electrode 19, the patient 11 and the cable 20.

Referring to FIG. 5 and 6, there is shown the modified flat connector indicated generally at 66 for connecting the line 22 to the disposable ground plate electrode 21. The connector 66 has a pair of identical clamp contact members 67 and 68 formed from conductive material, as sheet metal. The contacts 67 and 68 are enclosed in and secured to flat identical covers 69 and 71 of electrically insulative material such as plastic or the like. The contact members 67 and 68 are identical in structure and are located in spaced side relation in the cover to form a bi-polar connector.

As shown in FIG. 6, clamp contact member 67 comprises a pair of conductor members 72 and 73 having engaging transverse ribs 74 and 76 secured together, as by spot welds, to form a one-piece clamp. The center or body sections 77 and 78 of the members curve outwardly to form a transverse chamber 79. The forward portions of members 72 and 73 are flat contact plates 80 and 81 which are biased together by the curved sections 77 and 78. Projected upwardly from the front and rear edges of the sections 80 and 81 are pairs of upright ears 82 and 83 securing plates 80 and 81 to covers 69 and 81. The forward or front edges of the plate contacts 80 and 81 have transverse outwardly directed flanges 84 and 86 extending over the front side of cover walls 87 and 92 respectively. Flange 84 is located in a transverse groove 89 along the front side of wall 87.

Located on opposite sides of wall 87 are holes 88 for accommodating the ears 82. Wall 87 forms the bottom of the recess 90 in the cover 69 which is closed with a strip closure 91 mounted on the cover flush with the flat outer side of the cover 69. The member 72 is fastened to the wall 87 by turning the ears 82 over the top of wall 87. Member 73 is attached to the wall 92 with the forward flange 86 located in a transverse groove 94. The cover 69 has a recess 96 for the turned over ears 83 which is closed with a strip closure 97 mounted on the cover flush with the flat outer side of the cover 71.

With the members 72 and 73 secured to the walls 87 and 92 respectively, the transverse curved bodies 77 and 78 are in transverse engagement along bearing or fulcrum lines 98 and 99 with transverse mid-portions of the covers 69 and 71. The lines 98 and 99 extend along the mid-section of the covers rearwardly of the walls 87 and 92, so that movement of the covers 69 and 71 toward each other in the direction of arrows 100, the covers 69 and 71 will fulcrum along the fulcrum lines 98 and 99 spreading the plate contacts 80 and 81 whereby the ground plate electrode 21 may be inserted between the plate contacts 80 and 81. The biasing action of the curved sections 77 and 78 will hold the plate contacts 80 and 81 in flat surface engagement with opposite sides of the ground plate electrode 21.

The peripheral edges of covers 69 and 71 have inwardly directed side and end flanges 101 and 102 located in a relative lapped relation so that the covers can be moved toward each other and enclose the electrical connections of lines 43 and 44 to the clamp contact members 67 and 68 respectively.

As shown in FIG. 6, the front edges of covers 69 and 71 have forwardly projected and outwardly tapered

nose portions 103 and 104 which provide rearwardly converging guide surfaces leading to the plate contacts 80 and 81. The nose portions 103 and 104 extend transversely parallel to the plate contacts 80 and 81 and are separated from each other forming a mouth 94.

Referring to FIGS. 7 and 10, there is shown a further modified flat connector indicated generally at 106 attached to a line 107 adapted to be connected to an electrosurgical unit, as shown in U.S. Pat. No. 3,543,760. The connector 106 has a pair of cooperating flat electrically insulative identical covers 108 and 109 enclosing and mounting electrical clamp plates indicated generally at 111. The covers can be molded from plastic material, as a polycarbonate resin.

The clamp plates 111 comprise a pair of identical electrical conductor members 112 and 113 formed of sheet metal having transverse ribs 114 and 116 secured together by spot welds or the like. The ribs 114 and 116 are joined to outwardly curved body sections 117 and 118 terminating in transverse facing flat contact plates 119 and 121. The body sections 117 and 118 are curved in opposite directions and form a chamber or space 115 for the edge of the ground plate electrode 21. Transversely along the front of the plates 119 and 121 are outwardly directed flanges 123 and 124. Each member 112 and 113 is formed from a single metal blank which is stamped or otherwise deformed to make the rib, body contact plate and flange. Flange 122 has front and rear ears 124 which extend over a transverse wall 127 of the cover 108. The flange 122 projects into a transverse groove 129 located along the front of wall 127. Flange 123 is in a similar groove 131 located in the cover 109 adjacent the forward edge of wall 129. The contact plate 121 has ears 126 which extend over the edges of the wall 128 to secure the member 113 to the cover 109. As shown in FIG. 10, the ends of the contact plates 119 and 121 are also held in the covers 108 and 109 by side lips 108A and 109A.

Returning to FIG. 9, the ears 124 and 126 are in recesses 134 and 136 on the outer sides of the covers 108 and 109 respectively. The walls 127 and 128 form the bottom of the recesses as well as the supports for contact plates 112 and 113. Closure members 137 and 138 fit into the top of recesses 134 and 136 to close the recesses.

Covers 108 and 109 have transverse front nose portions 139 and 141 with converging faces leading to mouth 142. The nose portions 139 and 141 form the tapering transverse groove or mouth 142 which is used to direct the edge of the ground electrode directly in front of the contacting portions of the contact plates 119 and 121.

The outwardly directed body sections 117 and 118 have transverse and parallel pivot or fulcrum lines 143 and 144 for the covers 108 and 109. The inside mid- portions of the covers 108 and 109 contact the fulcrum lines 143 and 144 so that on squeezing the rear portions of the covers 108 and 109, as indicated by arrows 149, the nose portions 139 and 141 will move away from each other spreading the contact plates 119 and 121. On release of the squeezing force on the covers 108 and 109, the resilient spring action of the members 112 and 113 will force the contact plates 119 and 121 toward each other into surface contact with each other or a ground plate electrode.

The covers 108 and 109 have inwardly directed side and end flanges 146 and 147 which are offset relative to each other to enclose the rear portion of members 112 and 113. The flanges have hole 148 for the cord or line 109 which is attached to the flange 114 by a connection 151, shown in FIG. 8.

Connector 106 is usable to make an electrical connection with any type of electrical conductor member having a generally flat portion engageable with at least one of the plate contacts. The conductor covers are identical in size and shape so that they can be made from a single mold. The electrical conductor members 112 and 113 are also identical members secured together along ribs 114 and 116 to form a spring clamp. The ears 124 and 126 can be turned over with an assembling die to secure the contact plates to the covers 108 and 109.

There have been shown and described preferred embodiments of the ground electrode and connector. It is to be understood that various changes and substitutions and deletions may be made by those skilled in the art without departing from the spirit of the invention. The invention is defined in the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An electrical connector and plate electrode comprising in combination: a plate electrode comprising a one-piece flexible sheet member having a non-electrical base, an electrically conductive skin means substantially covering one side of the base, and means securing the entire inner side of said skin means to one side of the base, at least one hole in the sheet member, said skin means having substantial surface area for engagement with the surface of a body to make a large surface electrical contact between the skin means and the body, an electrical connector releasably attached to one portion of the plate electrode, said connector having a first lever and a second lever, at least one of said levers having flat electrical conductor means in substantial surface engagement with the skin means, holding means for maintaining the levers together in closed positions so that the flat electrical conductor means is held in surface engagement with the skin means, and one of said levers having at least one projection extended through the hole in the sheet member to prohibit separation of the electrical connector from the plate electrode when the levers are in their closed positions.

2. The combination of claim 1 wherein: the flat electrical conductor means comprise separated electrical contact plates, each plate having a substantially flat surface engageable with separate portions of the skin means.

3. The combination of claim 1 wherein: said electrically conductive skin means is electrically conductive aluminum.

4. The combination of claim 1 wherein: the base is cardboard and the skin means is electrically conductive aluminum.

5. A plate electrode for engaging the surface of a body and an electrical connector comprising: a plate electrode comprising a one-piece flexible sheet member having at least one hole and an electrically conductive skin means, said skin means having a sub-

stantial surface area for engagement with the surface of the body to make a large surface electrical contact between the skin means and the body, an electrical connector releasably attached to said sheet member, said electrical connector having electrical conductor means located in substantial surface engagement with the skin means, a portion of said electrical connector having at least one projection extended through said hole in the sheet member to prevent accidental separation of the connector from the sheet member, and means for maintaining the electrical conductor means in surface engagement with the skin means and the projection in the hole in the sheet member.

6. The combination of claim 5 wherein: the electrical conductor means has separated contact plates located in surface engagement with separate portions of the skin means.

7. The combination of claim 6 including: an electrically insulative cover located over the contact plates, said contact plates being secured to a portion of the cover.

8. The combination of claim 5 wherein: said electrically conductive skin means is electrically conductive aluminum.

9. The combination of claim 5 wherein: the base is cardboard and the skin means is electrically conductive aluminum.

10. An electrical connector and plate electrode comprising in combination: a plate electrode comprising a one-piece flexible sheet member having a non-electrically conductive base, an electrically conductive skin means substantially covering at least one side of the base, and means securing the entire inside of said skin means to said one side of the base, said skin means having a substantial surface area for engagement with the surface of a body to make a large surface electrical contact between the skin means and the body, an electrical connector releasably attached to the plate electrode, said connector having generally flat electrical contact plate means in substantial surface engagement with the skin means of the plate electrode, electrically insulative first cover means attached to the plate means and covering outer portions of the plate means, electrical line means attached to the plate means, means facing the plate means and engageable with the plate electrode on the side thereof opposite the plate means, electrically insulative second cover means attached to the means facing the plate means, pivoting means cooperating with the first cover means and the second cover means to control the pivotal movement of the first and second cover means, said connector having a space between the first and second cover means for an edge of the plate electrode, holding means for maintaining the first and second cover means together in closed positions so that the plate means is held in sur-

face engagement with the skin means, and coacting means on said plate electrode and on said connector operative to prohibit separation of the electrical connector from the plate electrode when the first and second cover means are in their closed positions, said first and second cover means adapted to receive a force operable to move the plate means away from the means facing the plate means thereby releasing the coacting means and permitting separation of the electrical conductor from the plate electrode.

11. The combination of structure of claim 10 wherein: said coacting means includes a hole in the plate electrode and a projection on one of said cover means, said projection being extended through said hole when the first and second cover means are in their closed positions to prevent accidental separation of the electrical connector from the ground plate electrode.

12. The combination of structure of claim 11 wherein: the electrical connector has separate substantially flat contact plates located in surface engagement with separate portions of the skin means.

13. The combination of claim 10 wherein: said electrically conductive skin means is electrically conductive aluminum.

14. The combination of claim 10 wherein: the base is cardboard and the skin means is electrically conductive aluminum.

15. A plate electrode for releasable attachment to an electrical connector of the type having a first means and a second means, at least one of said means having flat electrical conductor means, holding means for maintaining the first and second means together in closed positions, one of said first and second means having at least one extended projection, comprising: a one-piece flexible sheet member having an electrically non-conductive base, an electrically conductive skin means substantially covering at least one side of the base, said skin means having substantial surface area for engagement with the surface of a body to make a large surface electrical contact between the skin means and the surface of the body, means securing the entire inner side of said skin means to the base, at least one hole in the sheet member, said hole adapted to receive said projection of the electrical connector and said holding means maintaining the first and second means together in closed positions so that the flat electrical conductor means is held in substantial surface engagement with the skin means when the plate electrode is attached to the electrical connector.

16. The structure of claim 15 wherein: said electrically conductive skin means is electrically conductive aluminum.

17. The structure of claim 15 wherein: the base is cardboard and the skin means is electrically conductive aluminum.

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