July 27, 1965 T. H. CORBIN 3,196,877

DEFIBRILLATION ELECTRODE DEVICE

Filed Nov. 14, 1962 2 Sheets-Sheet 1

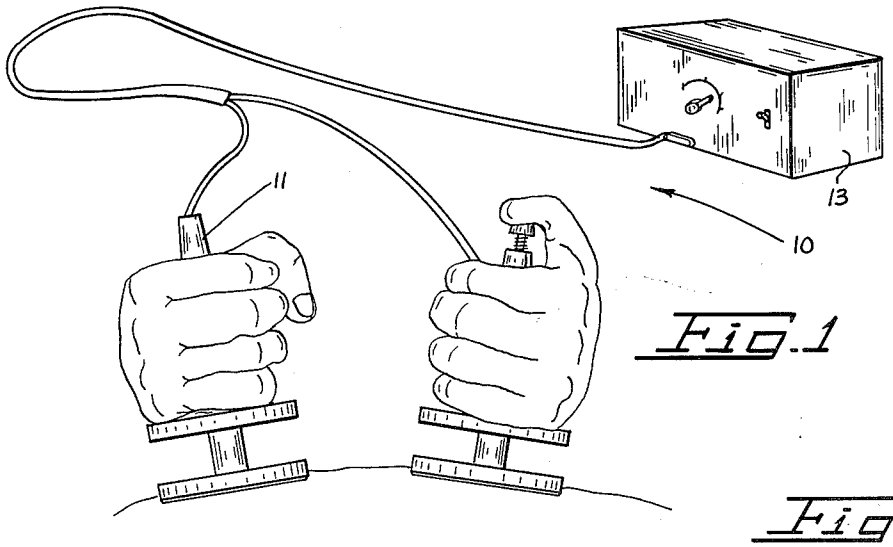


Fig. 1

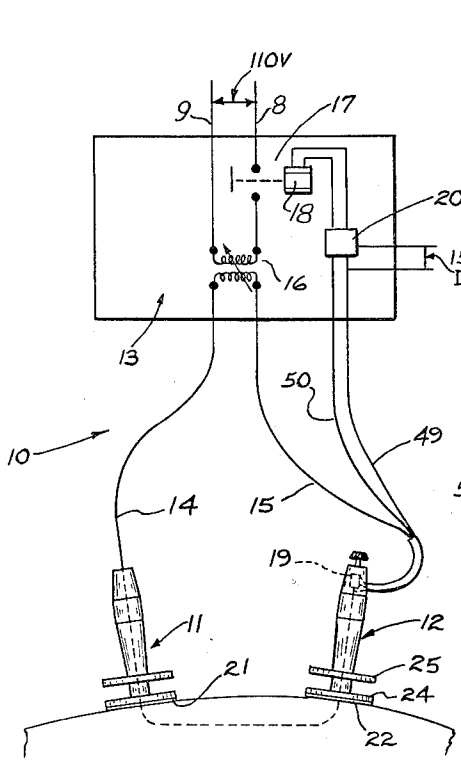
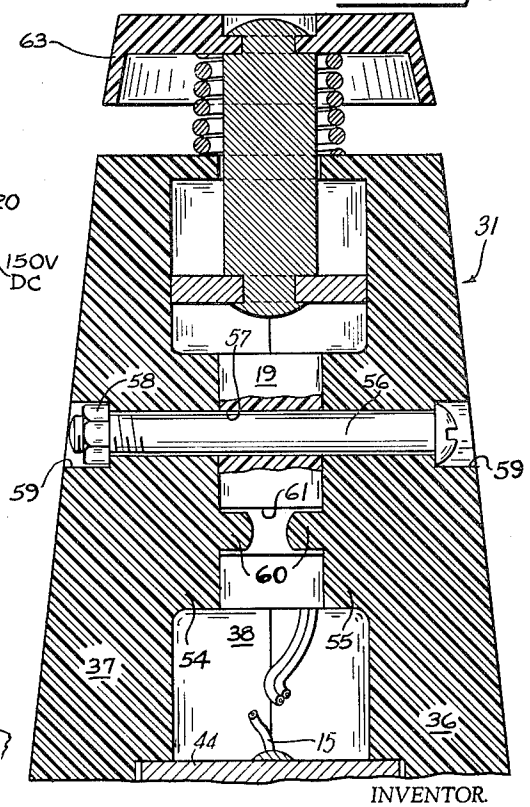


Fig. 2

Fig. 6



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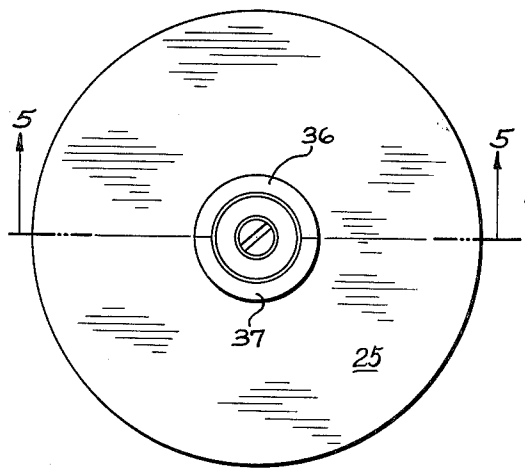

Fig. 4

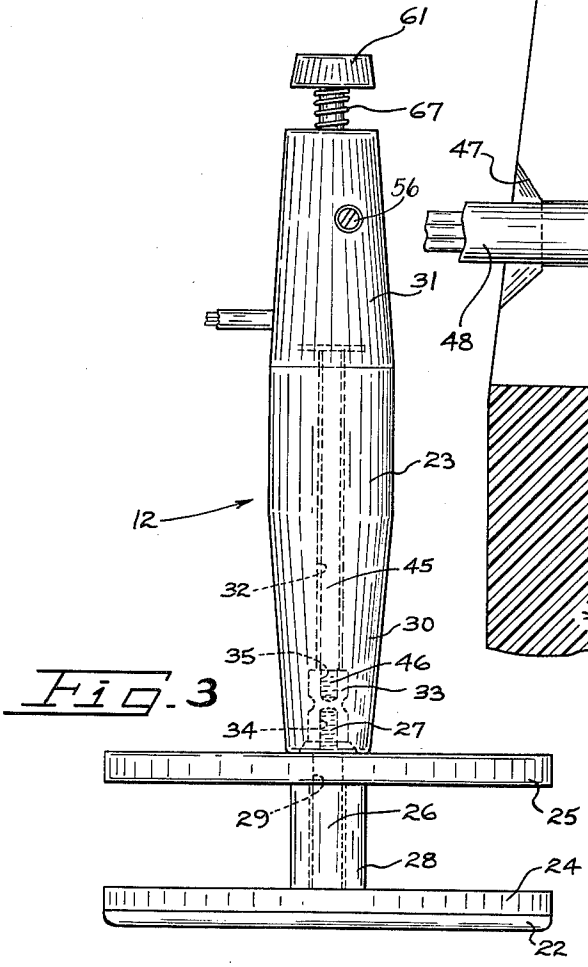

Fig. 3

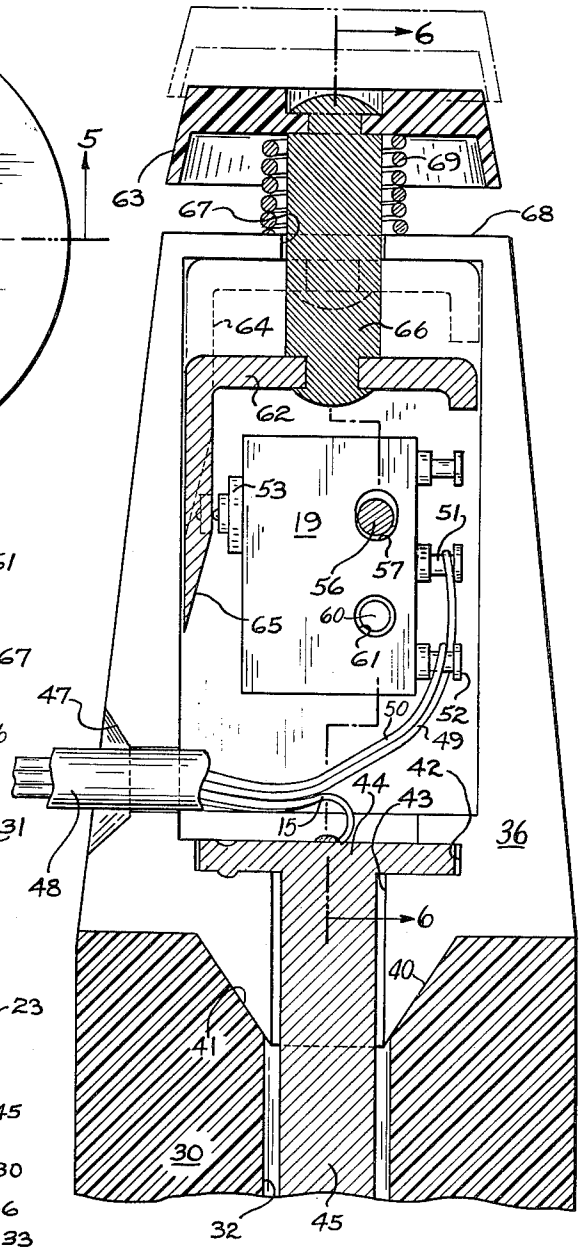

Fig. 5

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DEFIBRILLATION ELECTRODE DEVICE

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4 Claims. (Cl. 128—406)

This invention relates generally to medical apparatus and more particularly it relates to an electric shock producing device for use in cardiac resuscitation.

A common occurrence with victims of various heart diseases is that the heart suddenly lapses from its normal beat into fibrillation, which may be described as the condition wherein the heart muscle fibers quiver or tremor and beat independently and without rhythm. Unless this fibrillation is arrested within a short time and the normal beating and pumping of the heart is resumed, the patient will cease to live. Prior to the present invention it was discovered that this fibrillation condition could be arrested and a normal heart beat re-established by stimulating the heart muscles back into their normal action by applying electrical shocks to them. Originally, the technique was to apply the shock internally after making a chest incision. However, more recently the external treatment was proven to be a more practical technique wherein a pair of electrodes connected to a power source are applied directly to the body surface for passing timed pulses of electrical current through it.

In situations where such defibrillation equipment is to be used, time is of the essence. The equipment must therefore be easy to operate with a maximum of efficiency and safety. Moreover, it must be operable by a minimum of personnel who may have only limited training. Since relatively large amounts of electricity are being supplied, safety is an all important factor and particularly so because of the urgency and possible confusion involved in using the device.

It is therefore a general object of the present invention to provide an improved external defibrillation electrode apparatus capable of providing electrical shock treatment for cardiac resuscitation. More specifically, an object of the invention is to provide a defibrillation electrode device of the aforementioned type that is easy to operate by a single operator wherein the operator holding and positioning the electrodes on the patients can operate a switch attached to one of the electrode assemblies. This arrangement eliminates the need for any coordination between an operator holding the electrodes and another person controlling the flow of electrical current. It also prevents any chance for an accidental switch actuation and thereby provides maximum safety of operation. These important features are made possible by an arrangement of elements in accordance with the invention whereby the switch is enclosed within the electrode handle and is easily engaged by the thumb of the operator's hand by gripping the handle.

Another object of the invention is to provide an improved defibrillation electrode device that is capable of transmitting relatively high voltage pulses to the patient being treated with complete safety to both the operator and the patient.

Still another object of the invention is to provide a defibrillation electrode device for cardiac resuscitation that is particularly adaptable for ease and economy of manufacture.

Other objects, features, and advantages of the invention will become apparent from the following description presented in accordance with 35 USC 112.

In the drawings:

FIG. 1 is a view in perspective showing the apparatus embodying the principles of the invention when being used for cardiac resuscitation;

FIG. 2 is a view in elevation of the electrode assemblies together with a somewhat schematic diagram of the control console showing the electrical circuit for the defibrillation device according to the invention;

FIG. 3 is an enlarged view in elevation showing the electrode assembly of FIG. 2 having an enclosed control switch;

FIG. 4 is a plan view of the electrode assembly of FIG. 3;

FIG. 5 is an enlarged fragmentary view in elevation and in section taken along the line 5—5 of FIG. 4 and showing details of the upper portion of the electrode assembly;

FIG. 6 is another enlarged fragmentary view in elevation and in section of the upper portion of the electrode assembly of FIGS. 3–5 and taken along the line 6—6 of FIG. 5.

In the drawings, FIG. 1 illustrates an electrical cardiac resuscitation or defibrillation device 10 embodying the principles of the invention and shown as it is held when in actual use. Broadly, the device 10 comprises a pair of electrode assemblies 11 and 12, connected to a source of electrical power through a portable control console 13 that can be supported on a convenient stand or similar mount and located remotely from the patient being treated. As shown in FIG. 2 the control console 13 provides a means for receiving the electrical power from a suitable source (e.g. a standard 110 volt outlet) through a pair of leads 8 and 9, and houses a variable transformer 16 for boosting the input voltage to the desired level. The means for switching the current on and off in the supply leads 8 and 9 is provided by means of a main switch 17. Since the device 10 is built to provide an electrical current at a fairly high voltage, the surges through the lines 14 and 15 at the switch 17 often reach extremely high values (i.e. 300 amps., peak). Thus, in accordance with the invention, the main switch 17 is actuated by a contactor relay 18, which in turn is controlled by a miniature switch means 19 installed in a unique manner in the electrode assembly 12. An automatic timing device 20 is also provided in the circuit for miniature switch 19 and the relay 18, so that the electric shock produced by the device 10 on a patient will have a short predetermined duration (e.g. .15–.25 second). The timing device 20 may be of any suitable well known type and its function is to provide one pulse for one actuation of the switch 19. The use of the miniature switch means 19 within the electrode assembly 12 for controlling the main switch 17 is an important feature of my invention as will become apparent as the description proceeds.

As shown in FIG. 2, the main power leads 14 and 15 from the variable transformer 16 extend to the electrode assemblies 11 and 12, respectively. These assemblies are provided with circular end conductor plates 21 and 22, respectively, which are formed from a suitable conducting material such as a polished nickel steel, and means are provided in each electrode assembly for connecting a power lead 14 or 15 to its respective conducting plate. In the electrode assembly 11, which does not have the control switch 19, the power lead 14 extends through the upper end of the assembly and is connected internally to an elongated conductor (not shown) extending axially within the electrode assembly 11 and attached to its end conductor plate 21.

The electrode assembly 12, while outwardly having much the same appearance as the assembly 11 is provided with a different combination of elements including the aforementioned miniature switch means 19 for

controlling the flow of current in the electrode circuit. As shown in detail in FIGS. 3-6, the electrode assembly **12** has a double tapered handle manner **23** that is attached to a pair of insulating disc members **24** and **25**, all of said members **23**, **24** and **25** being formed of a rigid non-conductive plastic material such as a well known phenolic. The electrode plate **22** at the lower end of the assembly **12** is bonded to the insulation disc **24** and is provided with an upstanding central pin **26** having a threaded end portion **27** of reduced diameter. An insulating sleeve **28** of non-conductive plastic material fits around the pin **26** and extends upward to a point just below the threaded end portion **27**. This sleeve **28** serves as a spacer between the lower and upper insulating discs **24** and **25**. The upper disc **25** has a central opening **29** to receive the pin **26** and rests on top of the sleeve **28** with the threaded end **27** extending above its upper surface. The upper disc **25** serves as a safety means that prevents the operator's hands from inadvertently sliding down and touching the lower disc **24** and perhaps the electrode plate **22** itself.

The handle **23** has a lower tapered section **30** and an upper section **31** separable therefrom. The lower section **30** is provided with a central axially extending bore **32** within which at the lower end is rigidly fixed an internal sleeve **33** having internally threaded portions **34** and **35** at each end that are axially aligned with the bore **32**. The threads **34** at the lower end of the sleeve **33** correspond to the threads **27** on the pin **26** and enable the lower handle section **30** to be rigidly but removably attached to the parallel discs **24** and **25**.

The upper section **31** of the handle **23** is composed of two mating half sections **36** and **37** of preferably the same plastic material as the discs **24** and **25** and the lower handle section **30**. When attached together the sections **36** and **37** form an internal cavity **38** which houses the miniature switch **19** that controls the current through the electrode circuit. The lower end portion **40** of the upper handle section **31** formed by the mating sections **36** and **37** has a frusto conical shape which is adapted to fit within a similar conically shaped cavity **41** in the upper end of the lower handle section **30**. Above the end portion **40** the mating sections **36** and **37** are provided with a horizontal circular cavity **42** of uniform thickness and extending downward therefrom is a central bore **43** that is aligned with the bore **32** of the lower handle section **30**. The cavity **42** is adapted to retain a circular disc **44** that is attached to the upper end of an elongated conducting pin **45** having a lower threaded portion **46**. The lower threaded portion **46** is adapted to engage the upper threaded portion **35** of the sleeve **33** embedded in the lower handle section **30**. Thus, when the upper handle section **31** is assembled, the disc **44** is retained within the cavity **42** with its conducting pin extending downward through the bore **43**. The upper handle section **31** is readily engaged with the lower section **30** by inserting the pin **45** through the bore **32** and threadedly attaching it to the sleeve **33** therein.

The central cavity **38** of the upper body section is directly above the disc **44** and an inlet opening **47** is provided through the wall of the upper handle section **31** for an electrical conduit **48** which carries the main power lead **15** and also a pair of leads **49** and **50** for the miniature switch **19**. The opening **47** is formed by mating semi-cylindrical recesses in the mating handle sections **36** and **37** and is substantially the same diameter as the conduit **48** so that it grips the conduit tightly when the handle **23** is assembled. The lead **15** is soldered to the upper surface of the disc **44** and the leads **49** and **50** are attached to terminals **51** and **52** on the minature switch **19**. The switch **19** is preferably of the single pole, double throw type, which in various forms is commercially available in relatively small sizes. It is generally rectangular in shape and on the side opposite the terminals **51** and **52** is an inwardly movable button **53** for actuating the switch **19**. Within the cavity **38** of the upper handle section **31** of the handle **12** the switch **19** is mounted between a pair of inwardly protruding boss portions **54** and **55** having parallel axially extending faces. An attaching bolt **56** extends through the walls of the handle section **31** including the portions **54** and **55** and also through a passage **57** in the switch **19** itself. The head end of the bolt **56** and a nut **58** are retained in recesses **59** and provided on opposite sides of the upper handle section **31**. To more firmly secure the switch **19** a pair of aligned stabilizing projections **60** extend inwardly from the boss portions **54** and **55** and are adapted to fit within a second passage **61** extending through the switch **19** parallel to the first passage **57**.

The switch **19** is oriented within the handle **23** so that the button **53** is movable along a line perpendicular to the axis of the handle, and the button is actuated by means of an L-shaped member **62** that is movable axially within the cavity **38** by means of a thumb control member **63** at the end of the handle. The member **62** has an axially extending leg **64** of a substantial thickness that is tapered inwardly toward the switch from its end **65**, so when it is moved downwardly the beveled end **65** engages the button **63** and cams it inwardly to actuate the switch **19**. The thumb control member **63** is preferably formed from some non-conductive material such as nylon and has essentially the same diameter as the handle **23** and is attached to the member **62** by means of a pin **66** extending through an opening **67** in the end face **68** of the upper body section **31**. A coil spring **69** is fitted between the control member **63** and the end face **68** to keep the member **62** from actuating the switch button **53** until thumb control member **63** is forcefully pressed downwardly at the end of the handle.

Because of the aforementioned arrangement of elements of the defibrillation device **10** it can be operated with complete safety and effectiveness even by persons with limited experience. The chances for any mistiming of the electrical shock or of an inadvertent contact by the electrodes with other than the desired conductor when current is flowing, is completely eliminated.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

I claim:

1. An electrode assembly for a cardiac resuscitation device adapted to be energized from a source of electric power to produce an electrical shock through the human body to cause defibrillation of the heart muscles, said assembly comprising a circular metal disc forming an electrode plate, an upper layer of non-conductive plastic material forming an insulation disc and overlying and fixed to said electrode plate, an elongated handle of non-conductive plastic material having an outer portion formed to be gripped by the four fingers and palm of one hand, said handle having an interior cavity, said upper layer being removably connected to one end of the handle in fixed axial relation to the outer portion of the handle, a switch rigidly mounted within the cavity of said handle and having a control button extending outwardly from the side of the switch, electrical conduit means adapted to extend from the source of power, and extending through said handle and connected to said electrode plate and to said switch means, a spring-loaded thumb-actuated member on the other end of the handle and movable between advanced and retracted positions axially with respect to the outer grippable portion of the handle, said member including an exposed end surface adapted to be operable by the thumb of a hand gripping

the electrode assembly when the handle is gripped and positioned for use, an arm in the handle operatively coupled to the thumb-actuated member and movable therewith axially of the handle, said arm extending axially of the handle and including a contacting face portion spaced from the control button when said thumb-actuated member is in one of said positions and contacting and moving the control button when moving to the other of said positions.

2. An electrode assembly for a cardiac resuscitation device adapted to produce an electrical shock through the human body to cause defibrillation of the heart muscles, said assembly comprising:

an electrode plate;

an insulation disc bonded to said plate;

a handle connected to said disc;

said handle including an elongated lower portion of non-conductive plastic material with a central bore and a threaded sleeve aligned in said bore, said sleeve electrically connected to said electrode plate, and a pair of upper handle portions adapted to abut together and having internal recessions forming both an internal cavity and a circular transverse slot axially below said cavity, said upper handle portions having an opening for receiving an electrical conduit including a lead from a power source;

a contact disc of conductive material within said slot and attached to the end of said power lead, said disc having an attached metal pin extending axially downwardly therefrom, said pin extending through the bore of said lower handle portion and threadedly engaged to said sleeve thereby joining said upper handle portions to said lower handle portion;

a miniature switch means rigidly retained in said cavity between said abutting upper handle portions, said switch means including a control button extending exteriorly thereof, a spring-loaded thumb control means extending beyond the end of said handle and movable between projected and depressed positions to actuate said switch and thereby control the flow of current through said electrode plate, a rigid arm member movable axially of the handle and extending axially of the electrode assembly, said arm member including a contacting face portion spaced from the control button when said thumb control means is in one of said positions and contacting and moving the control button when moving to the other of said positions.

3. The device as described in claim 2 wherein said upper handle portions have integral raised portions within said recessions adapted to bear against opposite sides of said miniature switch means, a bore through said switch means and transverse bores aligned therewith, and bolt means extending through said transverse bores and said switch means to hold said upper handle portions together and said miniature switch in a predetermined position relative to said rigid arm member to align the arm member to engage and depress the control button.

4. The device as described in claim 2 wherein said rigid arm is L-shaped and has a beveled end portion forming a cam surface aligned and disposed to depress the exterior control button on said switch when the arm is moved by said thumb control means.

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RICHARD A. GAUDET, *Primary Examiner.*