United States Patent [19]

Bell

[11] **3,782,389**

[45] **Jan. 1, 1974**

[54] **COMPUTER CONTROLLED DEFIBRILLATOR**

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[73] Assignee: **Health Technology Labs, Inc.,** Omaha, Nebr.

[22] Filed: **Jan. 20, 1972**

[21] Appl. No.: **219,455**

[52] **U.S. Cl.** .... **128/419 D,** 128/421, 128/423, 324/111

[51] **Int. Cl.** **A61n 1/36**

[58] **Field of Search** .... 128/419 D, 419 P, 128/419 R, 420, 421, 422, 423; 324/111

[56] **References Cited**

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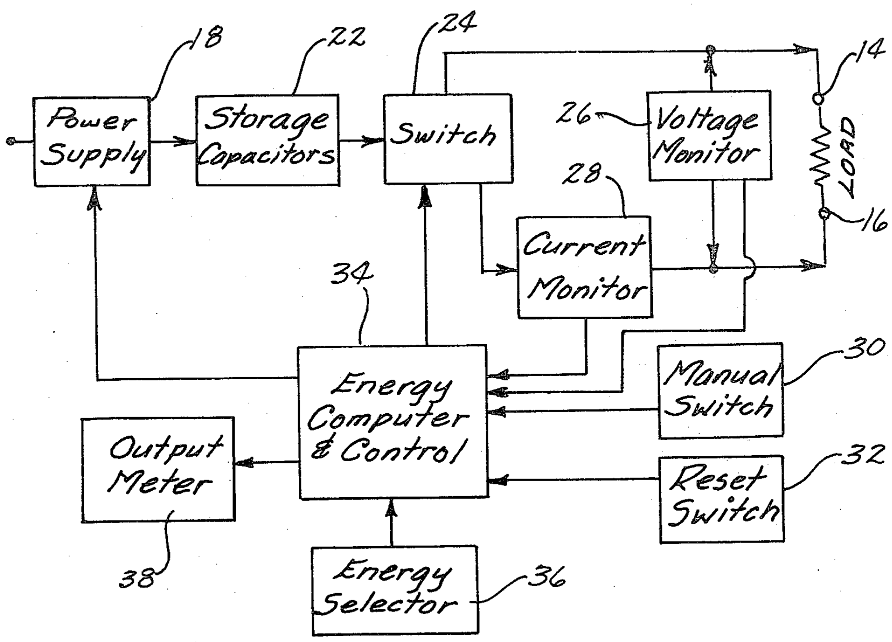
Primary Examiner—William E. Kamm
Attorney—Zarley, McKee & Thomte

[57] **ABSTRACT**

A computer controlled defibrillator comprising a set of electrodes which are engageable with a patient and which are connected to a source of electrical energy by a circuit means. The circuit means comprises storage capacitors, energy selector, computer, manual and reset switches, voltage monitor, current monitor, and output meter. The computer responds to certain external inputs, automatic and manual, and controls the output delivered to the patient. The energy selector permits the selection of the energy which is desired to be delivered to the patient. The sequence is started by closing the manual reset switch which zeroes the output meter and activates the power supply (electric energy) at a voltage which is dependent on the energy selector. The energy drived from the power supply is stored in the storage capacitors. The energy selector, which is manually set to the energy desired, also feeds an input to the computer. When the manual switch is activated, the computer causes the stored energy source to be connected to the patient through the electrodes. The current monitor and voltage monitor feed instantaneous signals to the computer which computes the energy as a continuous integration process. When the computer energy equals the selected energy, the computer causes the energy source to be disconnected from the patient. The total energy delivered to the patient is indicated as a steady reading on the output meter.

4 Claims, 6 Drawing Figures



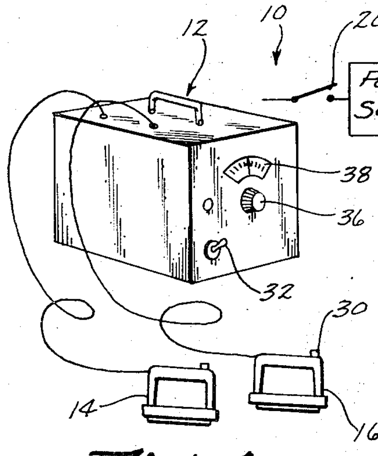


Fig. 1

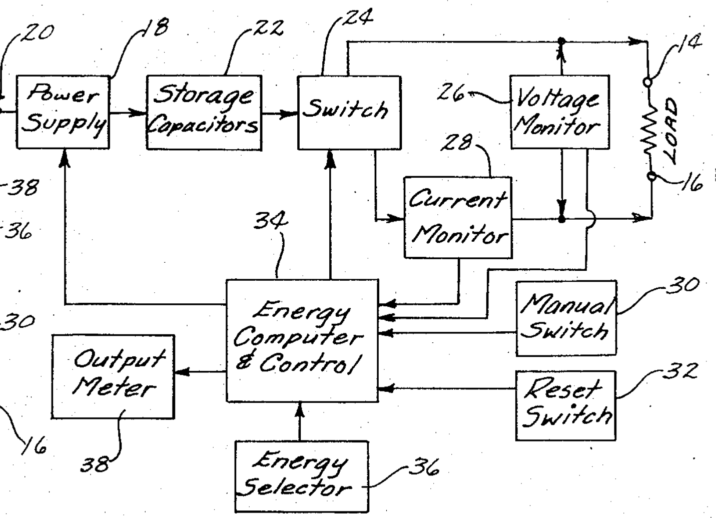


Fig. 2

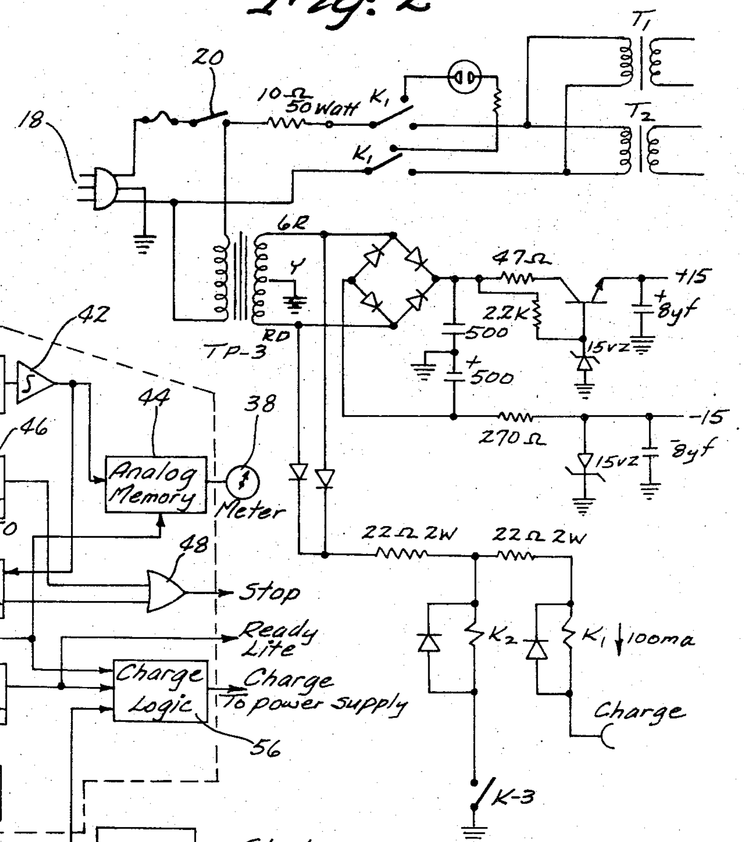


Fig. 4

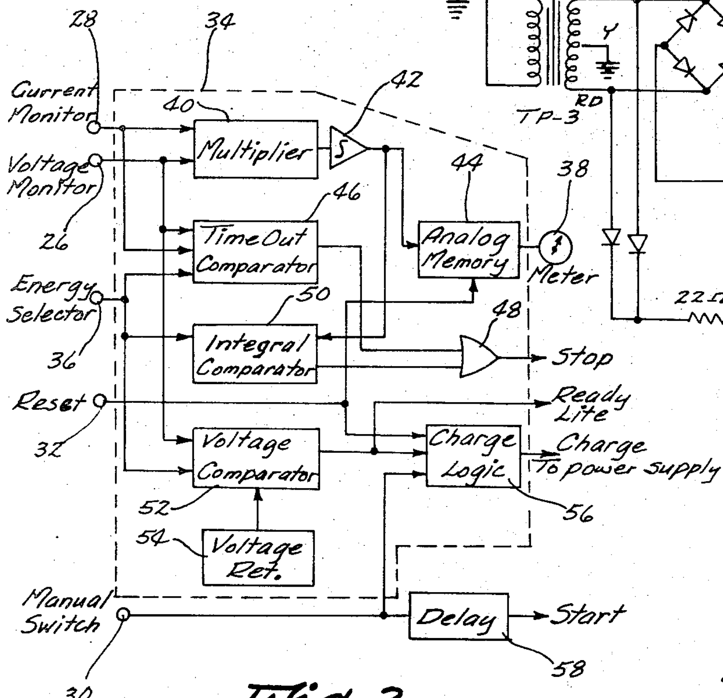
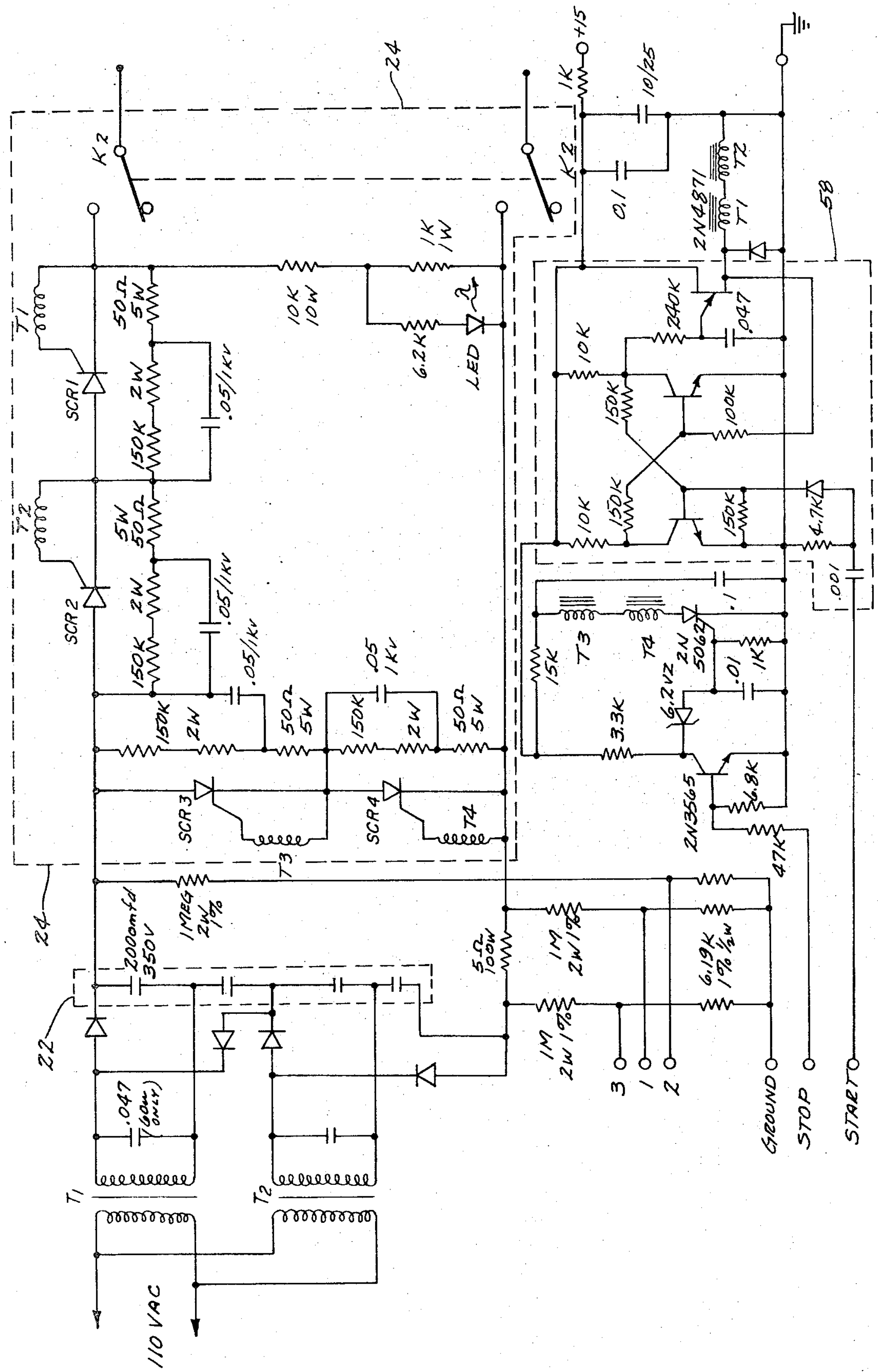


Fig. 3


24
K2
T1
SCR1
T2
SCR2
SCR3
SCR4
T3
T4
22
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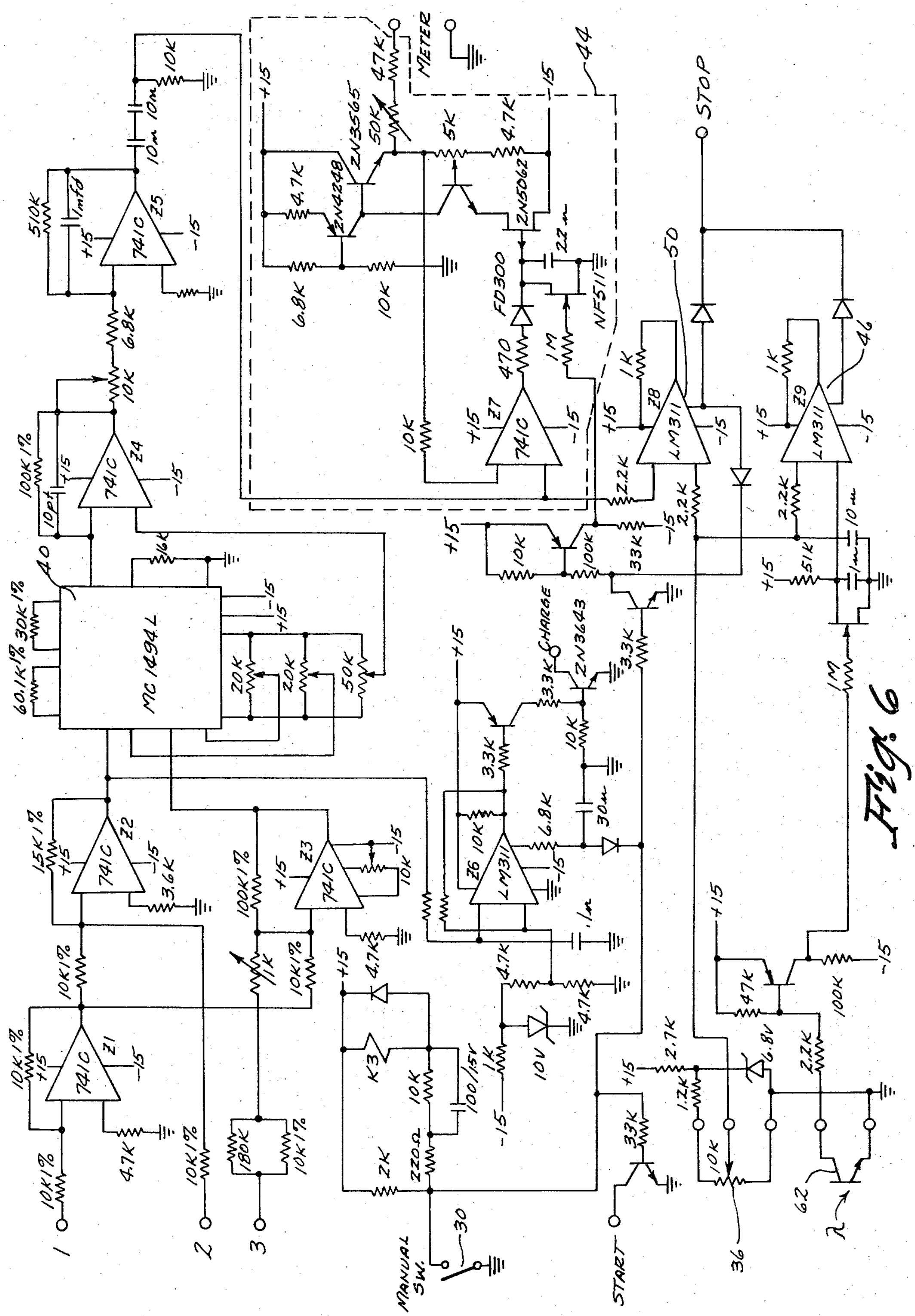
2N3565
110 VAC
3
1
2
GROUND
STOP
START
+15

Fig. 5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741C
LM311
METER
STOP
START
CHARGE
MANUAL SW.
2N3565
2N4248
2N5062
2N3643
FD300
NF511

Fig. 6

COMPUTER CONTROLLED DEFIBRILLATOR

The use of DC defibrillators in emergency resuscitation has become well established. Limitations due to weight have prevented more widespread use of the defibrillators. Most clinical defibrillators depend on the storage and discharge of energy through a stable RLC combination, thus requiring accurate capacitance, inductance and resistance. The conventional defibrillators employ a pair of electrodes or paddles which are placed in contact with the patient's chest. A defibrillation or electrical pulse is then applied to the patient, through the electrodes, to momentarily stop the heart so that fibrillation of the heart is stopped. Since time is critical in defibrillation techniques, it is extremely important that a sufficiently large impulse be applied to the patient during the first attempt. A majority of the prior art devices employ some means for selecting the energy to be delivered to the patient. However, it has been found that these devices generally deliver a smaller or lower output to the patient than that which was selected. A further complication is that the resistance of the patients vary greatly. Thus, the operator could possibly determine that it was necessary to apply an impulse of 200 joules to the patient. Quite often, the variances in the defibrillator and the variable resistance of the patient will result in considerably less than 200 joules being applied to the patient. If the pulse is insufficient to momentarily stop the patient's heart, the patient could possibly die.

Therefore, it is a principal object of this invention to provide an improved defibrillator.

A further object of this invention is to provide a defibrillator wherein the energy delivered to the patient substantially equals the selected energy.

A further object of this invention is to provide a defibrillator including a circuit means having an energy computer and control which computes the energy delivered to the patient and causes the energy source to be disconnected from the patient when the computed energy substantially equals the selected energy.

A further object of this invention is to provide a defibrillator which delivers the selected energy to the patient regardless of the resistance of the patient.

A further object of this invention is to provide a defibrillator which is light weight and portable.

A further object of this invention is to provide a defibrillator which is economical of manufacture, durable in use and refined in appearance.

These and other objects will be apparent to those skilled in the art.

This invention consists in the construction, arrangements, and combination of the various parts of the device, whereby the objects contemplated are attained as hereinafter more fully set forth, specifically pointed out in the claims, and illustrated in the accompanying drawings, in which:

FIG. 1 is a perspective view of the defibrillator of this invention.

FIG. 2 is a block diagram of the electrical circuitry of the defibrillator.

FIG. 3 is a block diagram illustrating the components of the energy computer and control and its relationship with other components of the device.

FIG. 4 is a schematic view of a portion of the circuitry of the invention.

FIG. 5 is a schematic view of more of the circuitry of the invention; and

FIG. 6 is a schematic view of more of the electrical circuitry of the invention.

The defibrillator of this invention is referred to generally by the reference numeral **10** and comprises a portable housing **12** having a pair of electrodes or paddles **14** and **16** connected to the circuitry therein as will be described in more detail hereinafter. The electrodes or paddles **14** and **16** are engageable with the patient to deliver a predetermined energy output to the patient to momentarily stop the patient's heart so that fibrillation of the heart is stopped.

The circuitry of the defibrillator is depicted in schematic form in FIG. 2 wherein the numeral **18** refers to a 110 VAC power supply having a switch **20** associated therewith. The power supply **18** is electrically connected to the storage capacitors **22** which are adapted to store energy derived from the power supply **18**. A "switch" mechanism **24** is connected to the storage capacitors **22**. Mechanism **24** is connected to the electrodes **14** and **16** as seen in FIG. 2 and to a voltage monitor means **26** and current monitor means **28**. Manual switch **30** and reset switch **32** are connected to the energy computer and control means **34**. Energy selector **36** is also connected to the computer and control means **34** as is the output meter **38**. Energy selector **36** may be comprised of a conventional rotatable dial or the like for setting the energy to be delivered to the patient.

The energy computer and control means **34** is illustrated in schematic form in FIG. 3. In FIG. 3, it can be seen that the current monitor **28** and voltage monitor **26** are electrically connected to the Multiplier **40** and that the Multiplier **40** is connected to an Integrator **42**. Integrator **42** is connected to an Analog Memory **44** which is connected to the meter **38**. The current monitor **28** and the voltage monitor **26** are also connected to a Time Out Comparator which is connected to the OR gate **48**. The energy selector **36** is connected to the Time Out Comparator **46**, Integral Comparator **50** and Voltage Comparator **52**. The Integral Comparator **50** is connected to the OR gate **48** and to the Integrator **42** as depicted in FIG. 3. Voltage Comparator **52** is connected to the Voltage Reference **54** and to the Charge Logic **56**. The Multiplier **40** is also connected to the Voltage Comparator **52**.

The reset switch **32** is electrically connected to the Analog Memory **44** and to the Charge Logic **56** while the manual switch **30** is connected to the Delay-Start **58** and to the Charge Logic **56**.

The heart of the control mechanism in the defibrillator is the energy computer and control **34** which responds to certain external inputs, manual and automatic, and controls the output delivered to the patient. In operation, the manual reset **32** starts the sequence by zeroing the output meter **38** and activating the power supply **18** at a voltage which is dependent on the energy selector **36**. Thus, if it were desired to deliver an impulse of 200 joules to the patient, the energy selector **36** would be set at 200 joules. The energy derived from the power supply **18** is stored in the storage capacitors **22**. The energy selector **36**, which is manually set to the energy desired, also feeds an input to the energy computer and control **34**. The electrodes or paddles **14** and **16** are then placed into contact with the patient and the

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