United States Patent

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[54] **COMBINATION DEFIBRILLATOR AND HEARTBEAT MONITORING SYSTEM**
5 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **128/2.06,** 128/419
[51] **Int. Cl.** **A61b 5/04**
[50] **Field of Search** ..... 128/2.05M, 2.06, 2.1, 419D, P(Digest), 419, 421–423

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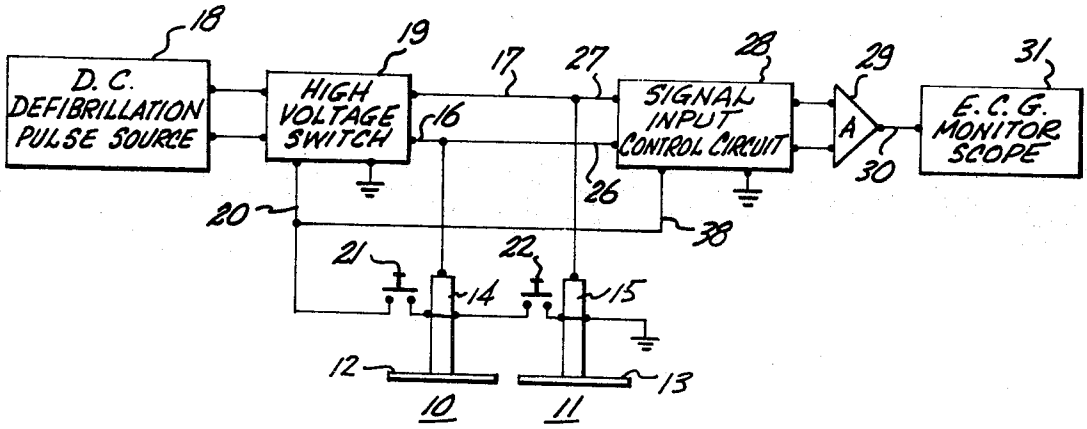
ABSTRACT: This application discloses a system wherein defibrillation signals are provided to a pair of defibrillator electrodes having control switches associated therewith for selectively activating the source of defibrillation signals and simultaneously deactivating the ECG system coupled with the electrodes. A single set of electrodes is utilized as the ECG pickup electrodes and as the defibrillator electrodes with the monitoring equipment being protected against the high voltages associated with the defibrillator circuitry. As a result the speed with which an operator can monitor a patient under emergency conditions and then apply defibrillation signals if required is greatly increased.



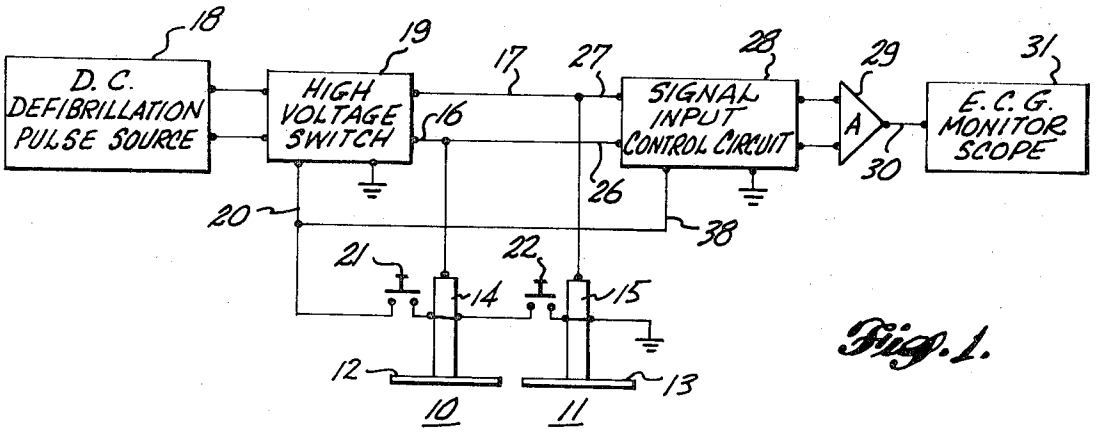


Fig. 1.

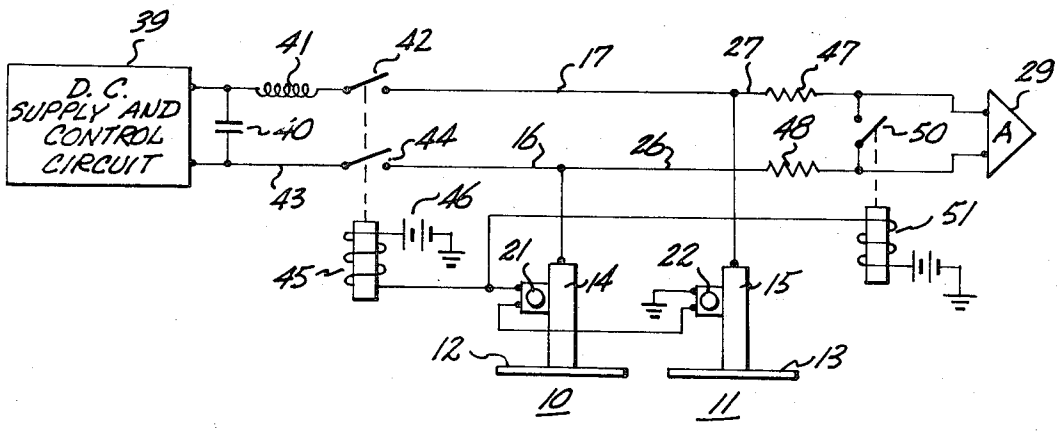


Fig. 2.

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COMBINATION DEFIBRILLATOR AND HEARTBEAT MONITORING SYSTEM

This invention relates to the field of monitoring the electrical activity of the heart of a person and selectively applying an electric impulse to the patient to stop fibrillation of the heart. In the past a set of ECG electrodes have been applied to the chest area of a patient using a conductive pastelike material to assure a good electrical connection between the ECG monitoring equipment and the patient. By monitoring the heartbeat it can be recognized when the heart is fibrillating and hence is in immediate need of a defibrillation signal to terminate the fibrillation. Once the need for a defibrillation signal has been recognized, a separate set of electrodes has been applied to the chest of the patient (again using a conductive paste to get good contact) and a high-voltage pulse signal then utilized via the defibrillation electrodes to momentarily stop the heart. In the case of an intensive care section of a hospital the monitoring electrodes are normally maintained in position on the patient.

It has long been recognized that in emergency situations the speed with which an operator can first determine whether or not a defibrillation pulse should be applied to the patient and then actually carry out the application of such pulse can literally mean the difference between life and death of the patient. In many emergency situations the time required to first monitor the patient and then apply the defibrillation electrodes for applying the defibrillation signal is further increased by the need to remove clothing from the chest area for the application of the multiple electrodes. It would therefore be advantageous to have some way of reducing the time element associated with detecting the need for a defibrillation pulse and actually applying the required pulse to the patient.

It is therefore an object of the present invention to provide an improved combination heart monitoring and defibrillation signal system wherein a single set of electrodes are utilized for purposes of monitoring the electrical activity of the heart of a patient and for selectively applying a defibrillation signal to the patient.

Another object of the present invention is to provide a set of defibrillation electrodes having additional control circuits associated therewith for selectively activating a source of defibrillation pulses and deactivating the monitoring equipment coupled to the electrodes.

Another object of the present invention is to provide a heart monitoring and defibrillating system utilizing a single set of electrodes for the signal pickup and for the application of defibrillation signals to the patient.

The above as well as additional advantages of the invention are achieved through the use of a set of relatively heavy electrodes capable of handling high-voltage signals and having additional control switches associated therewith for selectively activating a source of defibrillation signals and deactivating the heart monitoring equipment coupled to the patient via the defibrillation electrodes. In one preferred embodiment the high-voltage defibrillation signal source is coupled to the electrodes via a high-voltage switch controlled by a pair of control switch elements respectively positioned on the handles of the defibrillation electrodes. Thus when the defibrillation electrodes have been properly positioned on and in good electrical contact with the patient, the depression of the switches carried on the handles of the electrodes are closed to activate the high-voltage switch associated with the defibrillation signal source for the application of the defibrillation signal to the patient. By connecting the ECG monitoring scope or other monitoring equipment to the patient via the same electrodes and including appropriate protection circuitry for the monitoring equipment it is found that the single set of electrodes can be utilized for both functions of applying defibrillation signals and of picking up signals associated with the electric activity of the heart for the monitoring equipment.

In accordance with one preferred embodiment a relay is closed in response to the closure of a pair of control switches connected in series circuit and respectively positioned on the two defibrillation electrode handles. When the relay is energized a pair of high voltage switch contacts are closed causing a DC supply and control circuit to provide the required high-voltage pulse to the patient. A second relay associated with the input circuit of the heartbeat monitoring equipment is energized by closure of the switches on the handles of the defibrillation electrodes so that the input circuit for the monitoring equipment is effectively short circuited during the application of the defibrillation signal and hence the monitoring equipment is protected against any harm which might be caused by the high-voltage signal.

The above as well as additional advantages and objects of the invention will be more clearly understood from the following description when read with reference to the accompanying drawings wherein:

FIG. 1 is a block diagram of a preferred embodiment of the invention utilizing the novel combination pulse applying and signal pickup electrodes.

FIG. 2 is a system diagram similar to that of FIG. 1 showing the specific circuit arrangement for one preferred technique of carrying out the concepts of the present invention.

Turning now to the drawings, it will be seen that the system includes a pair of heavy defibrillation electrodes **10** and **11** each of which includes a heavy plate of conductive material shown as the platelike electrodes **12** and **13** on the ends of the insulating handles **14** and **15** used for applying the metallic surfaces **12** and **13** to the chest of the patient in accordance with the manner presently common in the art. The electrodes **10** and **11** are coupled by leads **16** and **17** to a source of high-voltage defibrillation signals **18** by way of the high-voltage switch **19**. The switch **19** is normally open and is closed in response to an input signal on the control lead **20** associated therewith. The lead **20** is seen to be connected to the thumb switches **21** and **22** respectively associated with the defibrillation electrodes **10** and **11**. In the specific example given the switches **21** and **22** are connected in series circuit and must both be closed in order for the high-voltage switch **19** to be closed. This assures the safety of the operator in that both hands must be on the insulating handles of the electrodes before the high-voltage pulse signal can be applied to the patient.

The leads **16** and **17** are seen to be connected to the leads **26** and **27** which go to the signal input control circuit **28** associated with the amplifier **29**. The output circuit **30** of amplifier **29** provides monitoring signals to the ECG monitor scope **31** which can be of the type well known and widely used at the present time. The signal input control circuit **28** has an input circuit **38** connected thereto which will be seen to be connected to the handle switches **21** and **22**. The circuit **28** is normally in a closed condition so that the monitoring equipment normally provides a visual indication of the heartbeat of the patient having electrodes **10** and **11** applied to his chest. The operator is therefore able to determine whether or not fibrillation of the patient's heart is occurring. If it is determined that fibrillation is taking place, the patient is immediately provided with a defibrillation pulse by the operator closing switches **21** and **22**. Closure of switches **21** and **22** serves to close the high-voltage switch **19** and open the signal input control circuit **28**. As a result there is no substantial time lag associated with determining the fact that a defibrillation pulse is needed and applying the defibrillation pulse to the patient.

In the circuit of FIG. 2 the pulse source is shown as including the DC power supply and control circuit **39** and a capacitor **40** connected by the pulse-shaping inductor **41** to a first set of relay contacts **42**. The lead **43** connects capacitor **40** to the second set of relay contacts **44**. The winding **45** associated with contacts **42** and **44** serves to close the contacts when the winding **45** is energized by the voltage supply **46**. This occurs only when both of the thumb-operated switches **21** and **22** on the handles of the electrodes **10** and **11** are closed.

While various circuit protection arrangements can be utilized in the input circuitry for the amplifier **29** to avoid damage thereto by the high-voltage signals, it will be seen in FIG. 2 that the input circuit for the amplifier **29** includes the high-value impedance elements **47** and **48** connected in the input

leads 26 and 27 for the amplifier. The value of the resistance elements 47 and 48 is not critical but need only be relatively large by comparison to the resistance offered by the body of the patient (typically in the order of 70 ohms) and small with respect to the input impedance of the amplifier. In the specific system illustrated resistors 47 and 48 were 20K ohms each. They therefore present a high impedance to the high-voltage pulse when the relay contacts 50 are closed by energization of the relay winding 51. It will be seen that the input circuit of the amplifier under such conditions will be short circuited and hence damage to the monitoring equipment is avoided due to the inherent capability of the amplifier to accommodate a short-circuited condition on the input terminals. Simultaneously the large value of the resistors 47 and 48 avoids any substantial effect on the defibrillation pulse being applied to the patient by the electrodes 10 and 11.

There has thus been disclosed an improved and simplified combination defibrillation and heartbeat monitoring system utilizing a single set of electrodes having control switch means associated therewith for the selective utilization of the electrodes as defibrillation or heartbeat monitoring electrodes. While the invention has been described by reference to the presently preferred embodiment it will be recognized to those skilled in the art that changes and modifications can be made without departing from the inventive concepts. In particular it will be recognized that other circuit protection arrangements can be utilized to avoid damage to the monitoring equipment when the single set of electrodes is utilized for the dual functions described.

I claim:

1. A heart monitoring and defibrillating system comprising in combination: a defibrillation signal source, heart signal display means, a set of electrodes engageable with a patient, and circuit means connecting said set of electrodes across said source and to said display means including manually-operated switch means controlling the selective application by an operator of a defibrillation signal to a patient from said source via said set of electrodes and further including means protecting said display means against damage from said defibrillation signal.

2. The system of claim 1 including an insulating handle connected to one of said electrodes and wherein said manually-operated switch means includes a first high-voltage switch connected to said source, a second control switch on said handle, and circuit means connecting said second switch with said first switch and maintaining the condition of said first switch under the control of said second switch.

3. The system of claim 2 including a second insulating handle connected to a second of said electrodes, and a third control switch on said second handle connected in circuit with said second control switch, such that said second and third switches must each be operated for the application of a defibrillation signal to the patient.

4. The system of claim 1 wherein said means protecting said display means includes a relay having controlled contacts in the circuit between said display means and said electrodes and controlled by said manually-operated switch means.

5. In a heart defibrillating and monitoring system having a source of high-voltage defibrillation signals and signal monitor means for monitoring signals indicating heart activity, the improvement comprising a single set of electrodes connected to the source and to the means for monitoring signals, manually-operated switch means connected between the electrodes and the source for controlling the application of defibrillation signals to a patient via the electrodes, and protection circuit means connected between the electrodes and said monitor means to protect said monitor means against high-voltage defibrillation signals, whereby the heart activity of a patient can be monitored by an operator using said electrodes as signal pickup electrodes for the monitoring equipment and then a defibrillation signal applied by the operator to the patient via the same electrodes without the need for separate electrodes for the two operations.

Dedication

3,547,108.—*Stanley V. Seiffert*, Seattle, Wash. COMBINATION DEFIBRILLATOR AND HEARTBEAT MONITORING SYSTEM. Patent dated Dec. 15, 1970. Dedication filed Jan. 15, 1975, by the assignee, *Physio-Control Corporation.*

Hereby dedicates to the Public the entire remaining term of said patent.

[*Official Gazette March 25, 1975.*]