



US005083562A

**United States Patent** [19]  
**de Coriolis et al.**

[11] **Patent Number:** 5,083,562  
[45] **Date of Patent:** Jan. 28, 1992

- [54] **METHOD AND APPARATUS FOR APPLYING ASYMMETRIC BIPHASIC TRUNCATED EXPONENTIAL COUNTERSHOCKS**
- [75] **Inventors:** Paul E. de Coriolis; John R. Batty, Jr., both of Miami, Fla.; Bruce J. Shook, North Andover, Mass.
- [73] **Assignee:** Teletronics Pacing Systems, Inc., Englewood, Colo.
- [21] **Appl. No.:** 574,510
- [22] **Filed:** Aug. 28, 1990

**Related U.S. Application Data**

- [63] Continuation of Ser. No. 397,637, Aug. 23, 1989, abandoned, which is a continuation of Ser. No. 145,515, Jan. 19, 1988, abandoned.

- [51] **Int. Cl.<sup>5</sup>** ..... A61N 1/36
- [52] **U.S. Cl.** ..... 128/419 D
- [58] **Field of Search** ..... 128/419 D

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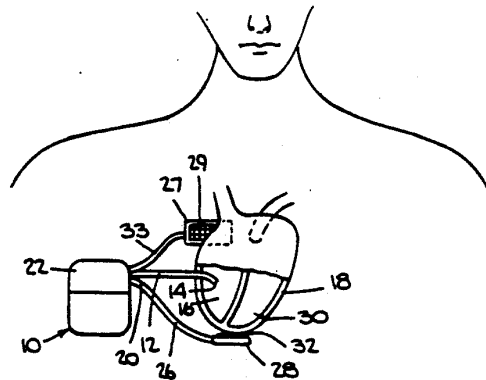
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**[57] ABSTRACT**

A method and apparatus for applying an asymmetric biphasic exponential waveform countershock to the heart useful in an implantable cardioverter or defibrillator, wherein the second phase has a start amplitude of substantially one half that of the first phase, and wherein the polarity of a capacitor discharging through a current path including the heart is reversed. A voltage reversing circuit may include a voltage shifter which shifts voltage associated with switching elements in the circuit to reduce voltage stresses in the switching elements.

**18 Claims, 4 Drawing Sheets**



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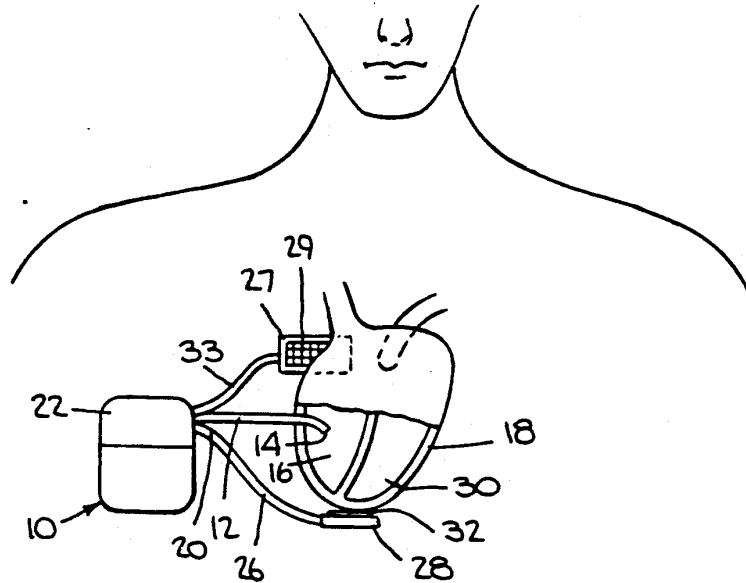


Fig. 1.

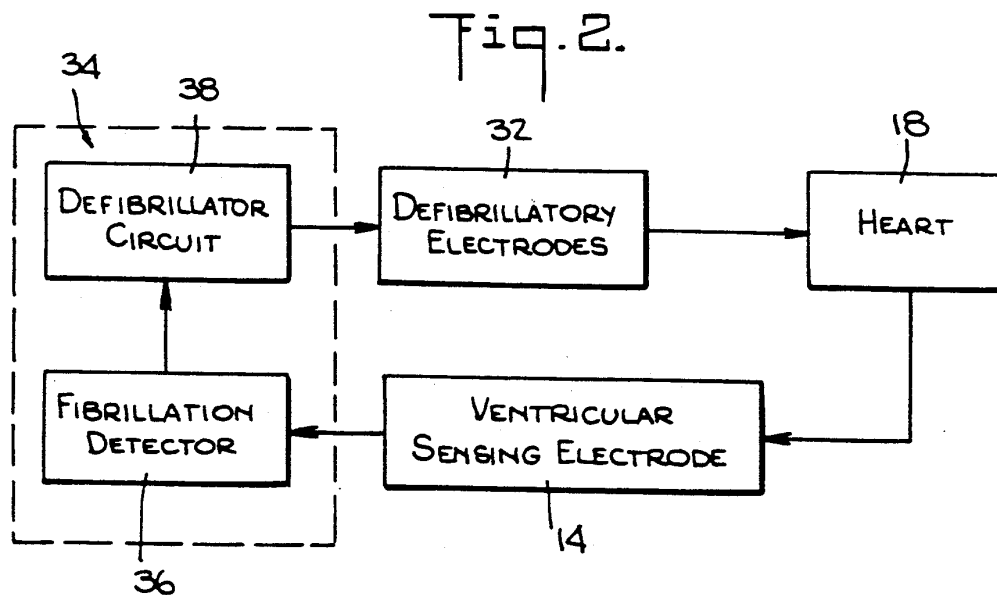
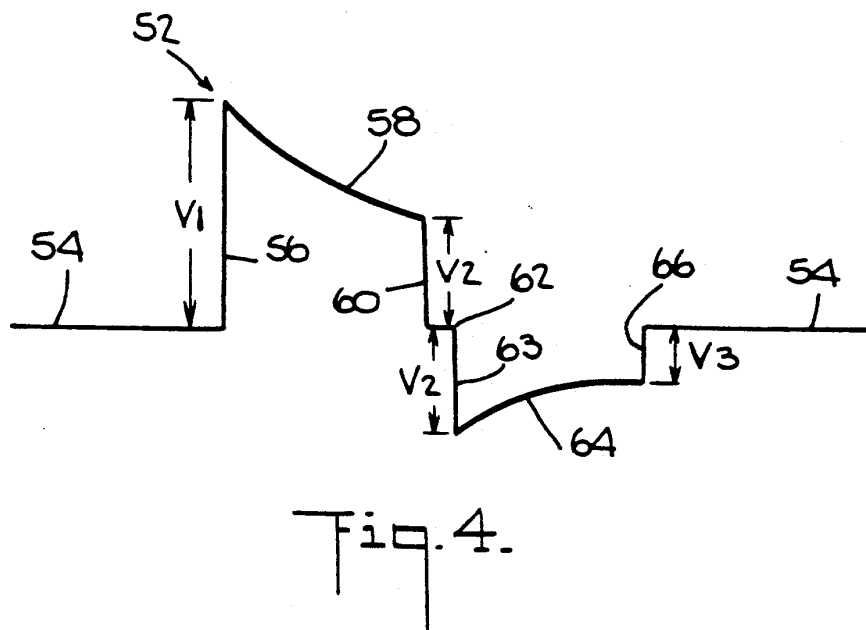
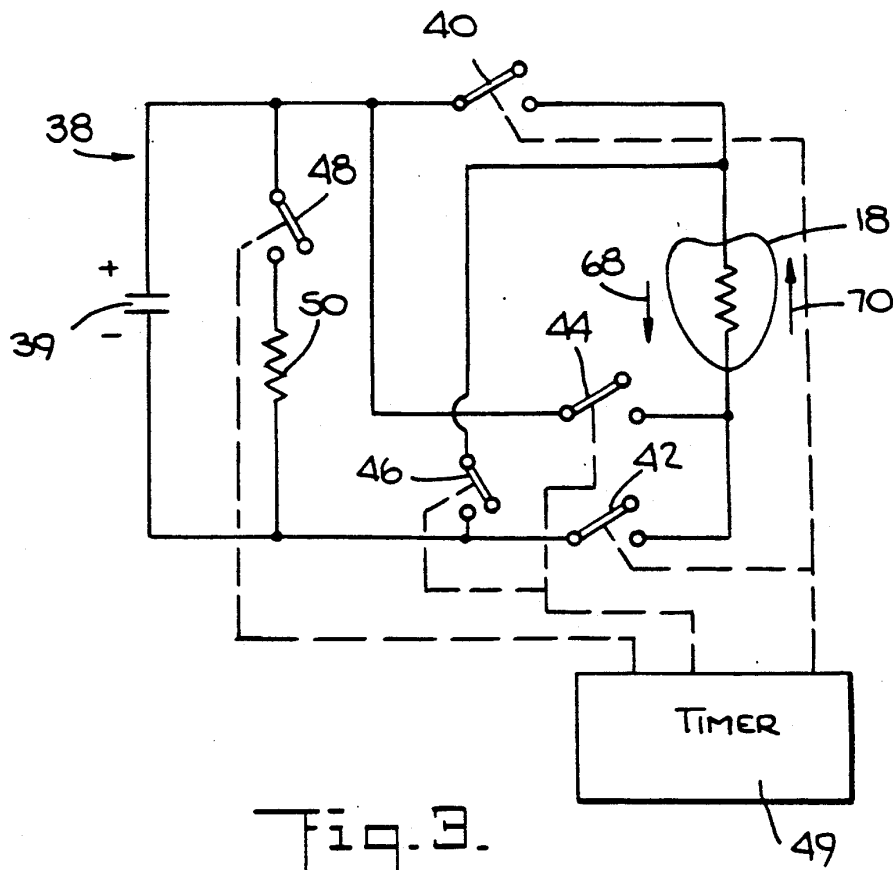


Fig. 2.



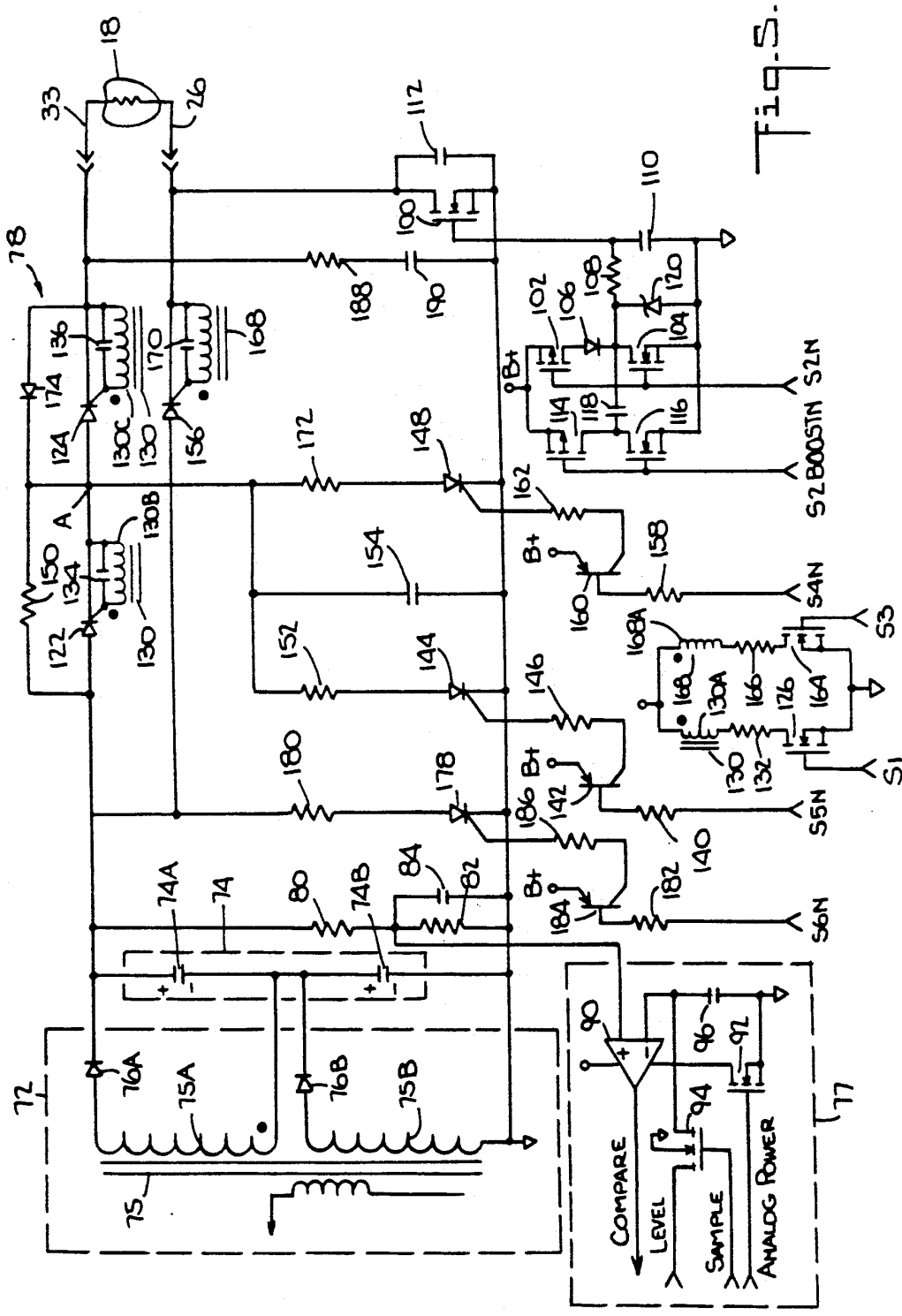


Fig. 5.

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