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(54) **DISABLE FOR ATRIOVENTRICULAR DELAY ADJUSTMENT**

DEAKTIVIERUNG ZUR ATRIOVENTRIKULÄREN VERZÖGERUNGSEINSTELLUNG

DÉSACTIVATION POUR UN AJUSTEMENT DE RETARD ATRIOVENTRICULAIRE

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Description

BACKGROUND

[0001] Implantable medical devices (IMDs) include devices designed to be implanted into a patient. Some examples of these devices include cardiac function management (CFM) devices such as implantable pacemakers, implantable cardioverter defibrillators (ICDs), cardiac resynchronization therapy devices (CRTs), and devices that include a combination of such capabilities. Such devices can include pacers, defibrillators, cardioverters, cardiac resynchronization therapy (CRT), or various combinations of such devices. Such devices can typically sense intrinsic heart contractions, deliver pacing pulses to evoke responsive heart contractions, or deliver a shock to disrupt certain arrhythmias. This can help improve the patient's heart rhythm or can help coordinate a spatial nature of the heart contraction, either of which may improve cardiac output of blood to help meet the patient's metabolic need for such cardiac output.

[0002] For example, detecting a ventricular tachyarrhythmia (e.g., a too-fast ventricular heart rhythm) often involves detecting a rate of ventricular heart contractions that exceeds a tachyarrhythmia rate threshold. By using multiple tachyarrhythmia rate thresholds, multiple tachyarrhythmia rate zones can be established, which can further classify different tachyarrhythmias based on which zone the heart rate falls within.

[0003] US 2004/0077963 A1 describes a cardiac rhythm management device including a dynamic mode switch for early detection of tachyarrhythmia. The algorithm of the management system automatically adjusts the time that an atrial pace (AP) and/or a ventricular pace (VP) is generated when the expected time of occurrence of the AP pulse falls within the lowest tachy zone LTR. The generation of the AP pulse is delayed until outside of the LTR. Thereby, the AV delay is decreased to a minimum and, if necessary, both the AP time and the VP time are delayed to preserve the minimum AV delay.

[0004] The invention is set out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] In the drawings, which are not necessarily drawn to scale, like numerals may describe similar components in different views. Like numerals having different letter suffixes may represent different instances of similar components. The drawings illustrate generally, by way of example, but not by way of limitation, various embodiments discussed in the present document.

FIG. 1 is an illustration of portions of a system that uses an implantable medical device.

FIG. 2 is an example of a timing diagram illustrating a manner in which timing cycles are set up in a multi-chamber pacemaker or pacemaker/defibrillator.

FIG. 3 is another example of a timing diagram illustrating a manner in which timing cycles are set up in a multi-chamber pacemaker or pacemaker/defibrillator.

FIG. 4 is an example of a timing diagram illustrating avoiding under-sensing by decreasing an AV delay.

FIG. 5 is a block diagram of portions of a device that adjusts an AV delay to avoid under-sensing of tachyarrhythmia.

DETAILED DESCRIPTION

[0006] An implantable medical device (IMD) may include one or more of the features, structures, methods, or combinations thereof described herein. For example, a cardiac monitor or a cardiac stimulator may be implemented to include one or more of the advantageous features and/or processes described below. It is intended that such a monitor, stimulator, or other implantable or partially implantable device need not include all of the features described herein, but may be implemented to include selected features that provide for unique structures and/or functionality. Such a device may be implemented to provide a variety of therapeutic or diagnostic functions.

[0007] FIG. 1 is an illustration of portions of a system 100 that uses an IMD 105. Examples of IMD 105 include, without limitation, a pacemaker, a cardioverter, a defibrillator, a cardiac resynchronization therapy (CRT) device, and other cardiac monitoring and therapy delivery devices, including cardiac devices that include or work in coordination with one or more neuro-stimulating devices, drugs, drug delivery systems, or other therapies. As one example, the system 100 shown is used to treat a cardiac arrhythmia. The IMD 105 typically includes an electronics unit coupled by one or more cardiac leads 110, 115, 125, to a heart of a patient or subject. The electronics unit of the IMD 105 typically includes components that are enclosed in a hermetically-sealed canister or "can." The system 100 also typically includes an IMD programmer or other external system 190 that communicates one or more wireless signals 185 with the IMD 105, such as by using radio frequency (RF) or by one or more other telemetry methods.

[0008] The example shown includes right atrial (RA) lead 110 having a proximal end 111 and a distal end 113. The proximal end 111 is coupled to a header connector 107 of the IMD 105. The distal end 113 is configured for placement

in the RA in or near the atrial septum. The RA lead 110 may include a pair of bipolar electrodes, such as an RA tip electrode 114A and an RA ring electrode 114B. The RA electrodes 114A and 114B are incorporated into the lead body at distal end 113 for placement in or near the RA, and are each electrically coupled to IMD 105 through a conductor extending within the lead body. The RA lead is shown placed in the atrial septum, but the RA lead may be placed in or near the atrial appendage, the atrial free wall, or elsewhere.

[0009] The example shown also includes a right ventricular (RV) lead 115 having a proximal end 117 and a distal end 119. The proximal end 117 is coupled to a header connector 107. The distal end 119 is configured for placement in the RV. The RV lead 115 may include one or more of a proximal defibrillation electrode 116, a distal defibrillation electrode 118, an RV tip electrode 120A, and an RV ring electrode 120B. The defibrillation electrode 116 is generally incorporated into the lead body such as in a location suitable for supraventricular placement in the RA and/or the superior vena cava. The defibrillation electrode 118 is incorporated into the lead body near the distal end 119 such as for placement in the RV. The RV electrodes 120A and 120B may form a bipolar electrode pair and are generally incorporated into the lead body at distal end 119. The electrodes 116, 118, 120A, and 120B are each electrically coupled to IMD 105, such as through one or more conductors extending within the lead body. The proximal defibrillation electrode 116, distal defibrillation electrode 118, or an electrode formed on the can of IMD 105 allow for delivery of cardioversion or defibrillation pulses to the heart.

[0010] The RV tip electrode 120A, RV ring electrode 120B, or an electrode formed on the can of IMD 105 allow for sensing an RV electrogram signal representative of RV depolarizations and delivering RV pacing pulses. In some examples, the IMD includes a sense amplifier circuit to provide amplification and/or filtering of the sensed signal. RA tip electrode 114A, RA ring electrode 114B, or an electrode formed on the can of IMD 105 allow for sensing an RA electrogram signal representative of RA depolarizations and allow for delivering RA pacing pulses. Sensing and pacing allows the IMD 105 to adjust timing of the heart chamber contractions. In some examples, the IMD 105 can adjust the timing of ventricular depolarizations with respect to the timing of atrial depolarizations by sensing electrical signals in the RA and pacing the RV at the desired atrial-ventricular (AV) delay time.

[0011] A left ventricular (LV) lead 125 can include a coronary pacing or sensing lead that includes an elongate lead body having a proximal end 121 and a distal end 123. The proximal end 121 is coupled to a header connector 107. A distal end 123 is configured for placement or insertion in the coronary vein. The LV lead 125 may include an LV ring or tip electrode 128A and an LV ring electrode 128B. The distal portion of the LV lead 125 is configured for placement in the coronary sinus and coronary vein such that the LV electrodes 128A and 128B are placed in the coronary vein. The LV electrodes 128A and 128B may form a bipolar electrode pair and are typically incorporated into the lead body at distal end 123. Each can be electrically coupled to IMD 105 such as through one or more conductors extending within the lead body. LV tip electrode 128A, LV ring electrode 128B, or an electrode formed on the can of the IMD 105 allow for sensing an LV electrogram signal representative of LV depolarizations and delivering LV pacing pulses.

[0012] The IMDs may be configured with a variety of electrode arrangements, including transvenous, epicardial electrodes (i.e., intrathoracic electrodes), and/or subcutaneous, non-intrathoracic electrodes, including can, header, and indifferent electrodes, and subcutaneous array or lead electrodes (i.e., non-intrathoracic electrodes). Some IMDs are able to sense signals representative of cardiac depolarizations using electrodes without leads.

[0013] As set forth above, tachyarrhythmia rate zones can be established, which can classify different tachyarrhythmias based on a zone the heart rate falls within. However, when an atrial pace is delivered at a heart rate that falls within a tachyarrhythmia rate zone, such a "fast" atrial pace can inhibit detection of a tachyarrhythmic intrinsic ventricular contraction that occurs close in time to the fast atrial pace. This, in turn, can prevent proper diagnosis or treatment of a ventricular tachyarrhythmia.

[0014] FIG. 2 is an example of a timing diagram illustrating a manner in which timing cycles are set up in a multichamber pacemaker or pacemaker/defibrillator. Starting with an intrinsic Ventricular beat (V) a time is established when ventricular pace (VP) electrical stimulation energy will be delivered by the pacemaker. In some examples this ventricular pace pulse interval is determined by programmable variables including the "maximum tracking rate" MTR and the "down-rate smooth limit" (drs). These two factors are multiplied to determine the ventricular pace pulse interval. For example, with a MTR of 500 and a drs of 1.12, the time interval from the sensed beat V to the next paced beat (VP) would be 560 milliseconds. FIG. 2 shows that there is a ventricular refractory period (VRP) associated with the intrinsic sensed event V and with the pace event VP.

[0015] In some examples this ventricular pace pulse interval is determined using an established lower rate limit (LRL) interval. The LRL interval can be a programmable variable, or the LRL interval can be determined from a programmable LRL. VP occurs when the LRL interval times out.

[0016] The atrioventricular (AV) delay value may be a parameter programmed in by the physician or can be a dynamic value calculated by the pacemaker. If the AV delay is dynamic a minimum AV delay may be specified in the IMD. The dynamic AV delay interval is not allowed to decrease below this specified value to preserve a minimum delay between an atrial pace and a ventricular pace.

[0017] The AV delay establishes the time of occurrence of the A-pace (AP) pulse produced by the implantable device.

A paced AV delay is subtracted from the ventricular pace pulse interval to determine the ventricular-atrial (VA delay) and the AP time.

[0018] FIG. 2 also shows that following the AP signal, a preprogrammed A-pace cross-channel refractory period is provided (VxAP). Finally, FIG. 2 shows a vertical line 205 to represent an interval to define a lowest tachyarrhythmia, or lowest tachy, rate (LRT) zone interval. Tachyarrhythmia is sometimes categorized into three rate zones - VF, VT, and VT-1. Zone VF is for ventricular fibrillation and is the highest rate zone. Zone VT is for ventricular tachycardia. Zone VT-1 is sometimes referred to as slow tachy. A programmed interval referred to as the "lowest tachy zone interval" defines the lower boundary of the VT-1 rate zone. It is the longest interval (slowest rate) that sensed beats can have and be classified as a tachycardia. This parameter varies from patient-to-patient and is arrived at by observing ECG data for the patient over a period of time.

[0019] FIG. 3 is another example of a timing diagram illustrating a manner in which timing cycles can be set up in a multi-chamber pacer or pacer/defibrillator. In this example, the determined VP pulse interval is less than the VP pulse interval in FIG. 2. In the example of FIG. 3, the calculated AP time is within the LTR zone interval indicated by the vertical line 305. An intrinsic ventricular event that occurs within the LTR zone can be possibly indicative of a tachyarrhythmia episode. The interval between the occurrence of the atrial pace (AP) and the vertical line 305 can be a zone in which under-sensing can occur. This can be due to the atrial cross-channel refractory period that follows the AP pulse. The atrial cross-channel refractory period that follows the AP pulse can inhibit sensing of an intrinsic ventricular event that occurs during the atrial cross-channel refractory period. This under-sensing can be avoided if the AV delay is decreased (or "squeezed") so that the calculated AP occurs outside the LTR zone.

[0020] An example of this is shown in the timing diagram example of FIG. 4. In the example of FIG. 4, the AV delay is reduced enough such that the AP pulse occurs outside the LTR zone interval shown by the vertical line 405. Note that in this example the VP pacing interval is preserved. In some cases, a physician or other user may set the LRL to a high value (or conversely, may set the LRL interval to a small value). For example, a short LRL may be desirable for pediatric patients, along with a corresponding shortened AV delay interval. This LRL AV delay may be programmed by the physician or other user, or may be calculated by the implantable device using the LRL interval. If the LRL interval is short enough (e.g., approaching the LTR zone interval) the calculated AP pulse may fall within the LTR zone interval. If the AV squeeze were not disabled, the device may move the AP pulse outside the LTR zone, potentially defeating the LRL interval desired by the physician. For this reason, if the LRL interval is programmed short enough so that it approaches the LTR zone interval, the "AV squeeze" that automatically decreases the AV delay to cause the AP to fall outside the LTR zone interval can be automatically disabled. Stated in equation form, if

$$(LTR\ zone\ Interval) > [(LRL\ Interval) - (AV\ Delay\ at\ the\ LRL)], \quad (1)$$

then the "AV squeeze" that automatically decreases the AV delay to cause the AP to fall outside the LTR zone is automatically disabled and the device will function using the short LRL interval and corresponding LRL AV delay desired by the physician. In some examples, the implantable device communicates a warning to an external system to indicate that the "AV squeeze" has been disabled.

[0021] FIG. 5 is a block diagram of portions of a device 500 that adjusts an AV delay to avoid under-sensing of tachyarrhythmia. The device 500 includes an electrical stimulation circuit 505. The electrical stimulation circuit 505 provides pacing electrical stimulation energy to an implantable ventricular electrode and an implantable atrial electrode. The device 500 also includes a ventricular sensing circuit 510 and a ventricular sensing circuit timer 515. The ventricular sensing circuit 510 detects intrinsic ventricular depolarizations including ventricular tachyarrhythmia depolarizations. The ventricular sensing circuit timer 515 initiates timing of the LTR zone interval and also initiates timing of the VP pulse interval. In some examples, the ventricular pace pulse interval is calculated using an established LRL interval.

[0022] The device 500 further includes an atrial pacing timer circuit 520. The atrial pacing timer circuit 520 calculates the AP pulse interval to follow the intrinsic ventricular depolarization using the ventricular pace pulse interval less a paced AV delay interval. If the calculated AP pulse interval is within the LTR zone interval, the atrial pacing timer circuit 520 delays generation of the AP pulse until after expiration of the LTR zone interval by decreasing the paced AV delay interval. As shown in FIG. 4, this "AV squeeze" moves the AP pulse to outside the LTR zone while preserving the ventricular pace pulse interval. If the LRL interval less the paced AV delay interval at the LRL is less than the LTR zone interval, the atrial pacing timer circuit 520 disables the "AV squeeze" decreasing of the paced AV delay interval. Thus, in the case where the LRL is set to a high rate (e.g. near the LTR zone) and the AV delay interval is already shortened, the "AV squeeze" feature, which automatically decreases the AV delay, is disabled.

[0023] In some examples, the device 500 includes a communication circuit to communicate with an external system. Because disabling the "AV squeeze" feature may result in under-sensing of ventricular tachyarrhythmia, the device communicates an indication to the external system that the "AV squeeze" feature is disabled. The external device

communicates an alert to the physician, such as by using a display of the external system.

[0024] In some examples, the external system determines from its monitoring of the therapy parameter settings of the implantable device that the "AV squeeze" feature that automatically decreases the AV delay is disabled. For example, if the external system knows the LTR zone Interval, LRL Interval, and the AV Delay at the LRL, settings of the implantable device, the external system can use Equation (1) to deduce the feature is disabled. The external device then communicates the alert to the physician.

[0025] The above detailed description includes references to the accompanying drawings, which form a part of the detailed description. The drawings show, by way of illustration, specific embodiments in which the invention can be practiced. These embodiments are also referred to herein as "examples." All publications, patents, and patent documents referred to in this document are incorporated by reference herein in their entirety, as though individually incorporated by reference. In the event of inconsistent usages between this document and those documents so incorporated by reference, the usage in the incorporated reference(s) should be considered supplementary to that of this document; for irreconcilable inconsistencies, the usage in this document controls.

[0026] In this document, the terms "a" or "an" are used, as is common in patent documents, to include one or more than one, independent of any other instances or usages of "at least one" or "one or more." In this document, the term "or" is used to refer to a nonexclusive or, such that "A or B" includes "A but not B," "B but not A," and "A and B," unless otherwise indicated. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Also, in the following claims, the terms "including" and "comprising" are open-ended, that is, a system, device, article, or process that includes elements in addition to those listed after such a term in a claim are still deemed to fall within the scope of that claim. Moreover, in the following claims, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects.

[0027] Method examples described herein can be machine or computer-implemented at least in part. Some examples can include a computer-readable medium or machine-readable medium encoded with instructions operable to configure an electronic device to perform methods as described in the above examples. An implementation of such methods can include code, such as microcode, assembly language code, a higher-level language code, or the like. Such code can include computer readable instructions for performing various methods. The code may form portions of computer program products. Further, the code may be tangibly stored on one or more volatile or non-volatile computer-readable media during execution or at other times. These computer-readable media may include, but are not limited to, hard disks, removable magnetic disks, removable optical disks (e.g., compact disks and digital video disks), magnetic cassettes, memory cards or sticks, random access memories (RAM's), read only memories (ROM's), and the like.

[0028] The following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separate embodiment. The scope of the invention should be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

Claims

1. A system (100) comprising:

an implantable medical device (IMD) (105) comprising:

an electrical stimulation circuit (505), configured to provide pacing electrical stimulation energy to an implantable ventricular electrode and an implantable atrial electrode;
a ventricular sensing circuit (510), configured to detect an intrinsic ventricular tachyarrhythmia depolarization;
a ventricular sensing circuit timer (515), configured to initiate timing of a lowest tachy rate (LTR) zone interval and also a ventricular pace pulse interval; and
an atrial pacing timer circuit (520) configured to:

calculate an atrial pace pulse interval to follow the intrinsic ventricular depolarization using the ventricular pace pulse interval less a paced atrioventricular (AV) delay interval;
delay generation of the atrial pace pulse until after expiration of the LTR zone interval by decreasing the paced AV delay interval when the calculated atrial pace pulse interval is within the LTR zone interval, thereby preserving the ventricular pace pulse interval; and
disable decreasing of the paced AV delay interval when an established lower rate limit (LRL) interval less the paced AV delay interval at the LRL is less than the LTR zone interval.

2. The system of claim 1, wherein the IMD (105) includes a communication circuit communicatively coupled to the atrial pacing timer circuit (520), wherein the atrial pacing timer circuit (520) is configured to communicate an alert from the IMD (105) to another device when disabling the decreasing of the paced AV delay interval.

3. The system of claim 1 or 2, including an external device (190) configured to: communicate information with the IMD (105);
determine the LTR zone and the LRL established in the IMD (105);
determine the paced AV delay at the established LRL;
calculate the LRL interval less the paced AV delay interval at the LRL using the external device; and
provide an alert to a user of the external device (190) when the LRL interval less the paced AV delay interval at the LRL is less than the LTR zone interval, wherein the alert indicates that the decreasing of the paced AV delay interval is disabled.

4. The system of claim 3, wherein the IMD (105) is configured to communicate the LTR zone and the LRL with the external device (190).

5. The system of claim 3 or 4, wherein the external device (190) is configured to receive the LTR zone and the LRL via a user interface.

6. The system of any one of claims 1-5, wherein the IMD (105) is configured to establish the LTR zone using a ventricular tachycardia detection zone.

7. The system of any one of claims 1-6, wherein the IMD (105) is configured to establish the LTR zone using a slow tachycardia detection zone.

8. The system of any one of claims 1-7, wherein the IMD (105) is configured to calculate the ventricular pace pulse interval using the LRL interval.

9. The system of claim 8, wherein calculating the ventricular pace pulse interval includes calculating a paced AV delay interval at the LRL and calculating the ventricular pace pulse interval using the calculated paced AV delay.

10. The system of claim 8, wherein calculating the ventricular pace pulse interval includes calculating the ventricular pace pulse interval using a programmable paced AV delay interval at the LRL.

11. The system of any one of claims 1-10, wherein the IMD (105) is configured to calculate the ventricular pace pulse interval using a maximum tracking rate and a down rate smoothing limit.

12. The system of any one of claims 1-11, wherein the IMD(105) is configured to deliver one or both of electrical cardioversion therapy and electrical defibrillation therapy.

13. The system of any one of claims 1-12, wherein the electrical stimulation circuit (505) is configured to provide pacing electrical stimulation energy to an implantable right ventricular electrode, an implantable left ventricular electrode, and the implantable atrial electrode.

Patentansprüche

1. System (100), welches aufweist:

eine implantierbare medizinische Vorrichtung (IMD) (105), welche aufweist:

eine elektrische Stimulationsschaltung (505), die konfiguriert ist zum Liefern von elektrischer Schrittgabe-Stimulationsenergie zu einer implantierbaren ventrikulären Elektrode und einer implantierbaren atrialen Elektrode;
eine ventrikuläre Erfassungsschaltung (510), die konfiguriert ist zum Erfassen einer intrinsischen ventrikulären Tachyarrhythmie-Depolarisation;
einen ventrikulären Erfassungsschaltungs-Zeitgeber (515), der konfiguriert ist zum Initiieren einer Zeitgabe eines untersten Tachyraten(LTRI)-Zonenintervalls und auch eines ventrikulären Schrittgabe-Impulsinter-

valls; und
eine atriale Schrittgabe-Zeitgeberschaltung (620), die konfiguriert ist zum:

Berechnen eines atrialen Schrittgabe-Impulsintervalls zum Folgen der intrinsischen ventrikulären Depolarisation unter Verwendung des ventrikulären Schrittgabe-Impulsintervalls abzüglich eines atrioventrikulären(AV)-Schrittgabe-Verzögerungsintervalls;
Verzögern der Erzeugung des atrialen Schrittgabeimpulses bis nach dem Ablauf des LTR-Zonenintervalls durch Verkleinern des AV-Schrittgabe-Verzögerungsintervalls, wenn das berechnete atriale Schrittgabe-Impulsintervall innerhalb des LTR-Zonenintervalls ist, wodurch das ventrikuläre Schrittgabe-Impulsintervall bewahrt wird; und
Deaktivieren des Verkleinerns des AV-Schrittgabe-Verzögerungsintervalls, wenn ein errichtetes unteres Ratengrenz(LRL)-Intervall abzüglich des AV-Schrittgabe-Verzögerungsintervalls bei der LRL kleiner als das LTR-Zonenintervall ist.

2. System nach Anspruch 1, bei dem die IMD (105) eine Kommunikationsschaltung enthält, die kommunikativ mit der atrialen Schrittgabe-Zeitgeberschaltung (520) gekoppelt ist, wobei die atriale Schrittgabe-Zeitgeberschaltung (520) konfiguriert ist zum Kommunizieren eines Alarms von der IMD (105) zu einer anderen Vorrichtung, wenn die Verkleinerung des AV-Schrittgabe-Verzögerungsintervalls deaktiviert wird.

3. System nach Anspruch 1 oder 2, enthaltend eine externe Vorrichtung (150), die konfiguriert ist zum:

Kommunizieren von Informationen mit der IMD (105);
Bestimmen der LTR-Zone und der in der IMD (105) errichteten LRL;
Bestimmen der AV-Schrittgabeverzögerung an der errichteten LRL;
Berechnen des LRL-Intervalls abzüglich des AV-Schrittgabe-Verzögerungsintervalls bei der LRL unter Verwendung der externen Vorrichtung; und
Liefern eines Alarms zu einem Benutzer der externen Vorrichtung (150), wenn das LRL-Intervall abzüglich des AV-Schrittgabe-Verzögerungsintervalls an der LRL kleiner als das LTR-Zonenintervall ist, wobei der Alarm anzeigt, dass die Verkleinerung des AV-Schrittgabe-Verzögerungsintervalls deaktiviert ist.

4. System nach Anspruch 3, bei dem die IMD (105) konfiguriert ist zum Kommunizieren der LTR-Zone und der LRL mit der externen Vorrichtung (190).

5. System nach Anspruch 3 oder 4, bei dem die externe Vorrichtung (190) konfiguriert ist zum Empfangen der LTR-Zone und der LRL über eine Benutzerschnittstelle.

6. System nach einem der Ansprüche 1 bis 5, bei dem die IMD (105) konfiguriert ist zum Errichten der LTR-Zone unter Verwendung einer ventrikulären Tachykardie-Erfassungszone.

7. System nach einem der Ansprüche 1 bis 6, bei dem die IMD (105) konfiguriert ist zum Errichten der LTR-Zone unter Verwendung einer langsamen Tachykardie-Erfassungszone.

8. System nach einem der Ansprüche 1 bis 7, bei dem die IMD (105) konfiguriert ist zum Berechnen des ventrikulären Schrittgabe-Impulsintervalls unter Verwendung des LRL-Intervalls.

9. System nach Anspruch 8, bei dem das Berechnen des ventrikulären Schrittgabe-Impulsintervalls das Berechnen eines AV-SchrittgabeVerzögerungsintervalls an der LRL und das Berechnen des ventrikulären Schrittgabe-Impulsintervalls unter Verwendung der berechneten AV-Schrittgabeverzögerung enthält.

10. System nach Anspruch 8, bei dem das Berechnen des ventrikulären Schrittgabe-Impulsintervalls das Berechnen des ventrikulären Schrittgabe-Impulsintervalls unter Verwendung eines programmierbaren AV-Schrittgabe-Verzögerungsintervalls an der LRL enthält.

11. System nach einem der Ansprüche 1 bis 10, bei dem die IMD (105) konfiguriert ist zum Berechnen des ventrikulären Schrittgabe-Impulsintervalls unter Verwendung einer maximalen Nachführungsrate und einer Abwärtsraten-Glättungsgrenze.

12. System nach einem der Ansprüche 1 bis 11, bei dem die IMD (105) konfiguriert ist zum Liefern von einer oder beiden

von einer elektrischen Kardioversionstherapie und einer elektrischen Defibrillationstherapie.

13. System nach einem der Ansprüche 1 bis 12, bei dem die elektrische Stimulationsschaltung (505) konfiguriert ist zum Liefern einer elektrischen Schrittgabe-Stimulationsenergie zu einer implantierbaren rechtsventrikulären Elektrode, einer implantierbaren linksventrikulären Elektrode und der implantierbaren atrialen Elektrode.

Revendications

1. Système (100) comprenant :

un dispositif médical implantable (IMD) (105) comprenant :

un circuit de stimulation électrique (505), configuré de manière à appliquer une énergie de stimulation électrique de stimulation cardiaque sur une électrode de ventricule implantable et sur une électrode d'oreillette implantable ;
un circuit de détection de ventricule (510), configuré de manière à détecter une dépolarisation de tachyarythmie ventriculaire intrinsèque ;
une minuterie de circuit de détection de ventricule (515), configurée de manière à initier un cadencement d'un intervalle de zone à rythme tachycardique le plus faible (LTR) et également d'un intervalle d'impulsion de stimulation cardiaque de ventricule ; et
un circuit de minuterie de stimulation cardiaque d'oreillette (520), configuré de manière à :

calculer un intervalle d'impulsion de stimulation cardiaque d'oreillette afin de suivre la dépolarisation ventriculaire intrinsèque en utilisant l'intervalle d'impulsion de stimulation cardiaque de ventricule moins un intervalle de retard atrio-ventriculaire (AV) stimulé ; à
retarder la génération de l'impulsion de stimulation cardiaque d'oreillette jusqu'à après l'expiration de l'intervalle de zone LTR en diminuant l'intervalle de retard AV stimulé lorsque l'intervalle d'impulsion de stimulation cardiaque d'oreillette calculé est à l'intérieur de l'intervalle de zone LTR, d'où ainsi la préservation de l'intervalle de stimulation cardiaque de ventricule ; et à
invalider la diminution de l'intervalle de retard AV stimulé lorsqu'un intervalle de limite de rythme plus faible (LRL) établi moins l'intervalle de retard AV stimulé à la LRL est inférieur à l'intervalle de zone LTR.

2. Système selon la revendication 1, dans lequel l'IMD (105) inclut un circuit de communication couplé en terme de communication au circuit de minuterie de stimulation cardiaque d'oreillette (520), dans lequel le circuit de minuterie de stimulation cardiaque d'oreillette (520) est configuré de manière à communiquer une alerte en provenance de l'IMD (105) à un autre dispositif lors de l'invalidation de la diminution de l'intervalle de retard AV stimulé.

3. Système selon la revendication 1 ou 2, incluant un dispositif externe (190) configuré de manière à :

communiquer une information avec l'IMD (105) ;
déterminer la zone LTR et la LRL établie dans l'IMD (105) ;
déterminer le retard AV stimulé à la LRL établie ;
calculer l'intervalle LRL moins l'intervalle de retard AV stimulé à la LRL en utilisant le dispositif externe ; et
fournir une alerte à un utilisateur du dispositif externe (190) lorsque l'intervalle LRL moins l'intervalle de retard AV stimulé à la LRL est inférieur à l'intervalle de zone LTR, dans lequel l'alerte indique que la diminution de l'intervalle de retard AV stimulé est invalidée.

4. Système selon la revendication 3, dans lequel l'IMD (105) est configuré de manière à communiquer la zone LTR et la LRL avec le dispositif externe (190).

5. Système selon la revendication 3 ou 4, dans lequel le dispositif externe (190) est configuré de manière à recevoir la zone LTR et la LRL via une interface utilisateur.

6. Système selon l'une quelconque des revendications 1-5, dans lequel l'IMD (105) est configuré de manière à établir la zone LTR en utilisant une zone de détection de tachycardie ventriculaire.

7. Système selon l'une quelconque des revendications 1-6, dans lequel l'IMD (105) est configuré de manière à établir

la zone LTR en utilisant une zone de détection de tachycardie lente.

8. Système selon l'une quelconque des revendications 1-7, dans lequel l'IMD (105) est configuré de manière à calculer l'intervalle d'impulsion de stimulation cardiaque de ventricule en utilisant l'intervalle LRL

9. Système selon la revendication 8, dans lequel le calcul de l'intervalle d'impulsion de stimulation cardiaque de ventricule inclut le calcul d'un intervalle de retard AV stimulé à la LRL et le calcul de l'intervalle d'impulsion de stimulation cardiaque de ventricule en utilisant le retard AV stimulé calculé.

10. Système selon la revendication 8, dans lequel le calcul de l'intervalle d'impulsion de stimulation cardiaque de ventricule inclut le calcul de l'intervalle d'impulsion de stimulation cardiaque de ventricule en utilisant un intervalle de retard AV stimulé programmable à la LRL.

11. Système selon l'une quelconque des revendications 1-10, dans lequel l'IMD (105) est configuré de manière à calculer l'intervalle d'impulsion de stimulation cardiaque de ventricule en utilisant un taux de suivi maximum et une limite de lissage de taux.

12. Système selon l'une quelconque des revendications 1-11, dans lequel l'IMD (105) est configuré de manière à délivrer une thérapie prise parmi une thérapie de cardioversion électrique et une thérapie de défibrillation électrique. ou ces deux thérapies.

13. Système selon l'une quelconque des revendications 1-12, dans lequel le circuit de stimulation électrique (505) est configuré de manière à fournir une énergie de stimulation électrique de stimulation cardiaque à une électrode de ventricule droit implantable, à une électrode de ventricule gauche implantable et à l'électrode d'oreillette implantable.

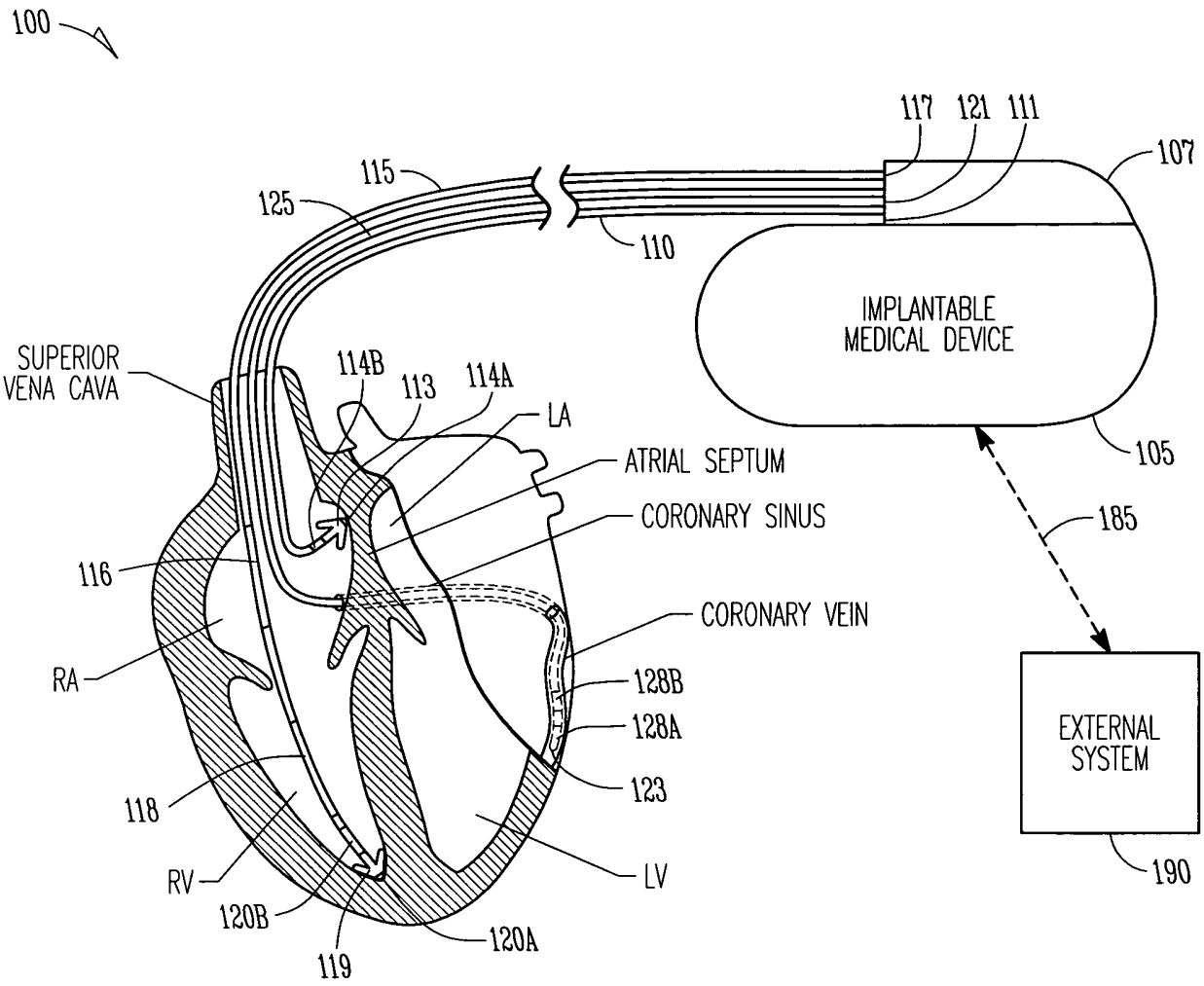
100
117
121
111
107
115
125
110
IMPLANTABLE
MEDICAL DEVICE
105
185
SUPERIOR
VENA CAVA
114B
113
114A
LA
ATRIAL SEPTUM
CORONARY SINUS
116
CORONARY VEIN
RA
128B
128A
123
118
LV
RV
120B
120A
119
EXTERNAL
SYSTEM
190

Fig. 1

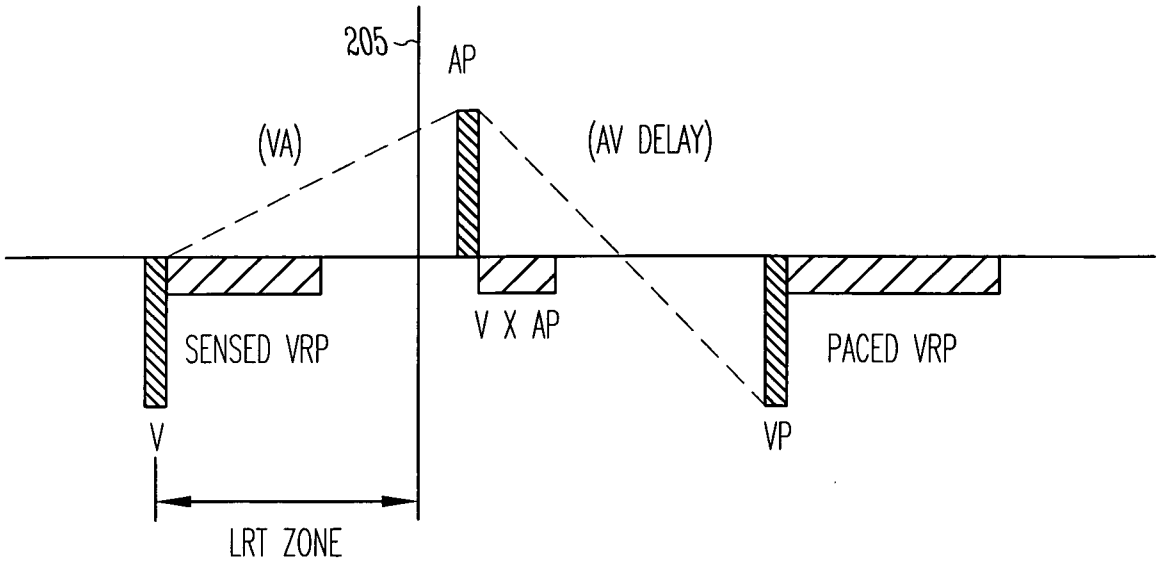
205
AP
(VA)
(AV DELAY)
SENSED VRP
V X AP
PACED VRP
V
VP
LRT ZONE

Fig. 2

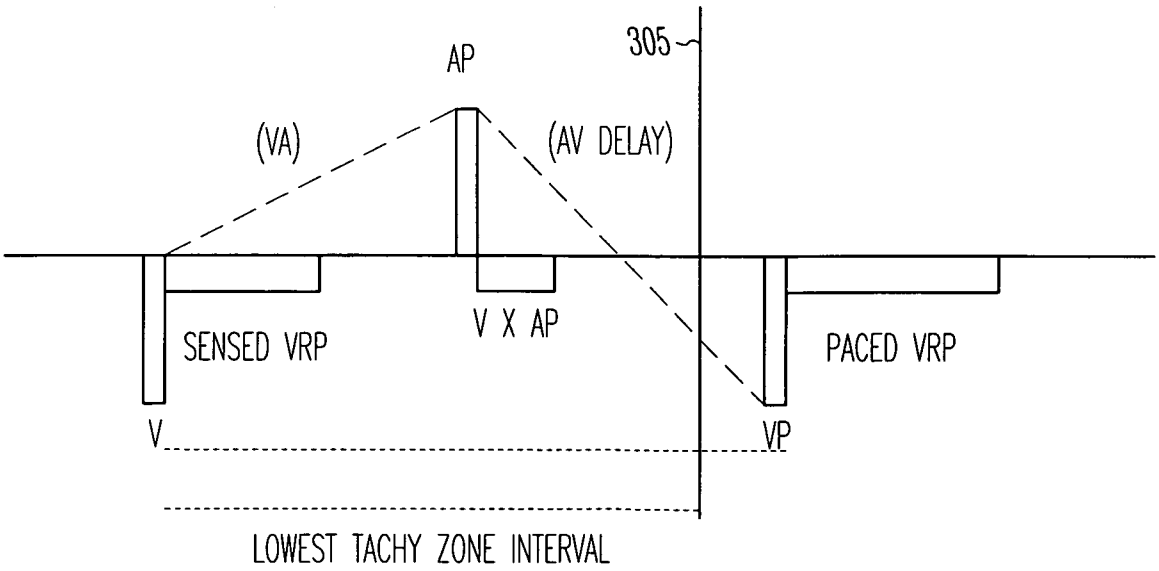
305
AP
(VA)
(AV DELAY)
SENSED VRP
V X AP
PACED VRP
V
VP
LOWEST TACHY ZONE INTERVAL

Fig. 3

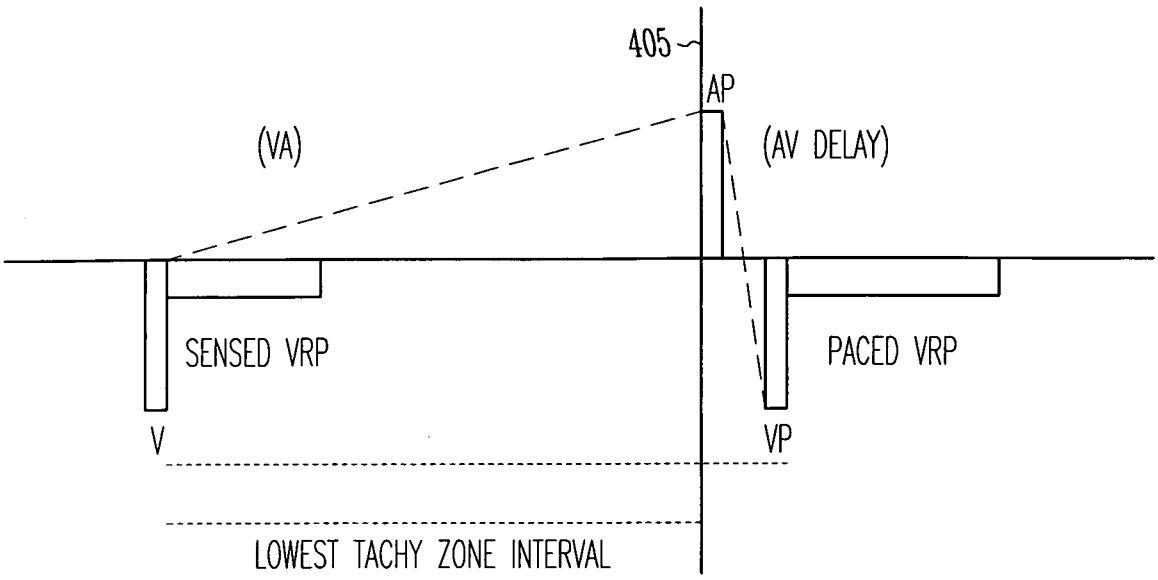
405
AP
(VA)
(AV DELAY)
SENSED VRP
PACED VRP
V
VP
LOWEST TACHY ZONE INTERVAL

Fig. 4

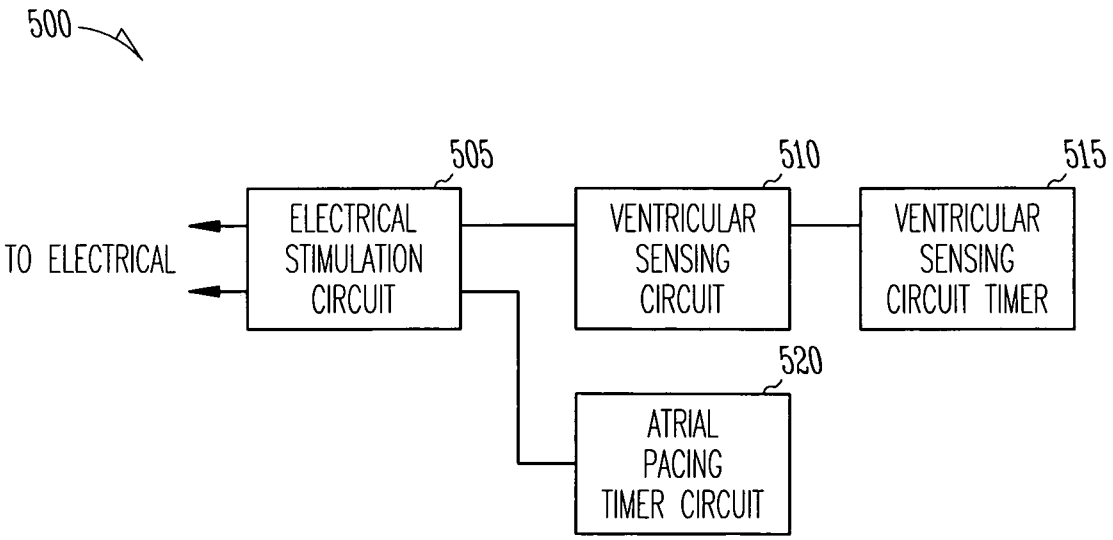
500
505
510
515
TO ELECTRICAL
ELECTRICAL STIMULATION CIRCUIT
VENTRICULAR SENSING CIRCUIT
VENTRICULAR SENSING CIRCUIT TIMER
520
ATRIAL PACING TIMER CIRCUIT

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20040077963 A1 **[0003]**

专利名称(译)	禁用房室延迟调整		
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CPC分类号	A61N1/3622 A61B5/0464 A61N1/3682 A61N1/37258		
优先权	61/005504 2007-12-04 US		
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摘要(译)

一种装置包括电刺激电路，心室感测电路，心室感测计时器和心房起搏计时器。心室感测电路检测内在的室性快速性心律失常去极化。心室感测计时器启动最低快速率（LTR）区间隔的定时以及使用较低速率限制（LRL）计算的心室起搏间隔。心房起搏计时器使用心室起搏间隔减去起搏房室（AV）延迟间隔来计算心房起搏间隔以跟随内在心室去极化，通过减少起搏AV延迟来延迟心房起搏的产生直到LTR区间隔期满后当计算的心房起搏间隔在LTR区间隔内时间隔，并且当LRL间隔减去LRL的起搏AV延迟间隔小于LTR区间隔时，禁止起搏AV延迟间隔的减小。