External Pacemaker of Diagnose and Research, Experience in Military Hospital Center Mexico.

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Abstract. - The present paper shows the design and development the External Pacemaker Circuit, for used in diagnose or Research of diseases than affect the heart. In this case they are used lineal circuit, existent in the Mexican National Market.

We design and used a simple prototype for generation pulse for heart stimulation by employ the oscillators with the circuit LM555.

Previous results obtained in Military Hospital Centre in Mexico displayed good operation in the electrical impulses from the hear muscle cause your hear to beat (Contract)

Build up this type of Pacemaker is the objective, in this paper show how was the development of a circuit that cold sense the heart rhythm and could supply the impulses necessaries to live.

The most relevant is your use in medical person the Military Hospital Center in Mexico City, as diagnose and research tool.

Index Terms.- Pacemaker, Heart, Oscillators Circuit, LM555.

I. INTRODUCTION

Arrhythmias of the heart can be very detrimental to heart function. Such abnormal ties are often treated with pacemakers. Pacemakers can function in many ways, depending on the mode of operation and the design choices for your components of the pacemakers. The technological advances that have developed over the past three decades, especially integrated circuit technology, allow for pacemakers to be titrated for specific patient needs, to serve as a diagnostic tool o some the agree, and to optimize cardiac output in rate-responsive pacing .

Vital to all cardiac function is the spontaneous and repetitive generation of electrical impulses by the heart. These impulses control the sequence of muscle contraction of each heartbeat. The pattern and timing of these impulses determines the heart rhythm. Abnormalities of this rhythm impair the hearts ability to pump blood as the body demands.

The figure 1 show the heart in cross section, normally, the heartbeat begins in the right atrium when the sinoatrial (SA) node, a special group of cells, transmits an electrical signal across the heart. This signal spreads throughout the atria and to the atrioventricular (AV) node. The AV node connects to a group of fibers in the sinoatrial node is the heart's pacemaker, the ventricles that conducts the electrical signal and sends the impulse to all parts of the ventricles. This exact route must be followed to ensure that the heart pumps properly.

As the electrical impulse cross through the heart the heart contracts. This normally occurs about 60 to 100 times per minute, with each contraction equaling a single heartbeat. The atria contract about one-fifth of a second before the ventricles, allowing them to empty their blood into the ventricles before the ventricles contract.

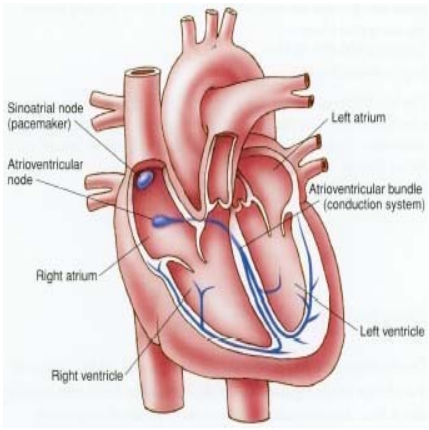

Fig.1. Show the heart in cross section and node sensitive the hearts pacemaker.

The cardiac pacemaker is an electric stimulator that produces periodic electric pulses conducted to electrodes located on the surface of heart (epicardium), within the heart muscle (myocardium), or within the cavity of the heart or the lining o the heart (endocardium). The stimulus thus conducted to the heart causes it to contract, this effect can be used prosthetic ally in disease states in witch the heart is not stimulated at a proper rate on its own [2].

Pacemaker can help pace the heart in cases of slow heart rate, fat and slow heart rate, or a blockage in the heats electrical system.

There are different pacemakers, one the sends pulses to the heart so that it beats to a rhythm hat have been determined of fixed rhythm. Their name is asynchronous.

Another class can sense the heart's rhythm and turn them selves off when the heartbeat is above a certain level. They will turn on again when the heartbeat is too slow.

These types of pacemakers are called demand pacemakers. The prototype that was developed works as a demand pacemaker and it is in the capacity to sense if exists or not heart rhythm.

II. MATERIALS AND METHODS

2.1. Description Circuit.

The circuit consists of two integrate circuit timer (LM55) which control the opening and closing one start switch, The first circuit is used in astable operation and determines the heart rate witch may be altered between 30 a 320 beats/minute by adjusting the variable resistor. The second circuit regulated the pulse width which determines the ratio between systole and diastole (duty cycle) this situation is control by one second resistor, alters this ratio to produce a change in systolic time which results is the change in stroke volume of the ventricle.

The equal forms, the circuit they have a two light emitting diodes (LED), which are used as visual indicators of the duration the pulse width (ventricular ejection) and operation the voltage power, through the regulator circuit whose magnitude is controller with three resistor provides + 5 voltage to the timing circuit.

The block diagram of pacemaker circuit is illustrated in the Figure 1.

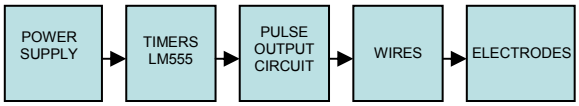

Fig.1. Diagram a block the electronic pacemaker.

The design the experimental pacemakers describe in the above diagram depicts a simple asynchronous pacemaker where the uniform pulsing rates produce by his oscillator. The pulse output circuit generates pulses in either a constant current or constant voltage, which are transmitted to the heart via the electrodes.

2.2. Pulse Generation (Stimulation).

The amplitude and pulse duration of the pacemaker depended on whether the pacemaker is operating in constant- current or constant-voltage [3] The constant current mode, the pulse current is constant, typically from 8 to 10 mA with a duration of 1.0 to 1.2 ms. In this developed in the principal characteristic is the constant-Voltage mode, the voltage is maintained at 5.0 to 5.5 Volts with duration of 0.5 a 0.5 ms. these threshold values are half the chronic values. The diagram below shows pulses of varying widths.

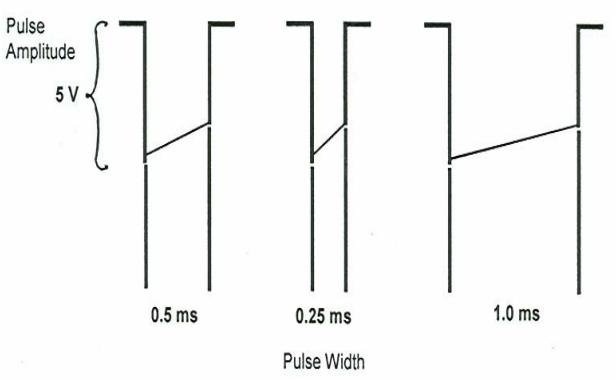

Fig.2. Show standard value the pulse generator, correspond the chronic values. The pulses sent out by the pacemaker to the heart cause the heart to contract. This is referred to as stimulation. A pulse is characterized by pulse width and pulse amplitude.

2.3. Clinical measurements protocol

To verify the performance of the pacemaker proposed in real conditions, measurements were performed over medical procedures in the Military Hospital Center in Mexico City, previous the authorization of the medical protocol.

Whose results are registered through an electrocardiography monitor the high-speed in such a way that can reproduce the wave form stimulate pacemaker what constitute an advance step to prove the results the circuit pacemaker in real measures.

2.4. Patient.

Patients feminine with 35 year-old, were studied and previous laboratory study, she has been practiced surgery for the inserted electro catheter via the femoral arterial, what enables the connection of the external pacemaker.

III. RESULTS.

3.1. Experimental System (Simulated)

Previous to the assembling of electronic components and testing of the circuit pacemaker, the design was simulated through the program Electronics Workbench in that first stay was looked to obtain the pulses generation, as well as the variability of pulse according to the characteristics the pacemaker mode (constant-Voltage), indicated to maintained at 5.0 to 5.5 Volts with duration of 0.5 a 0.5 ms, to effect of producing the stimulation sign of the pacemaker. Weaker pulses either not lasting long enough(less pulse width) or lesser strength(less amplitude) may not cause stimulation. The results shown in the figure 4.

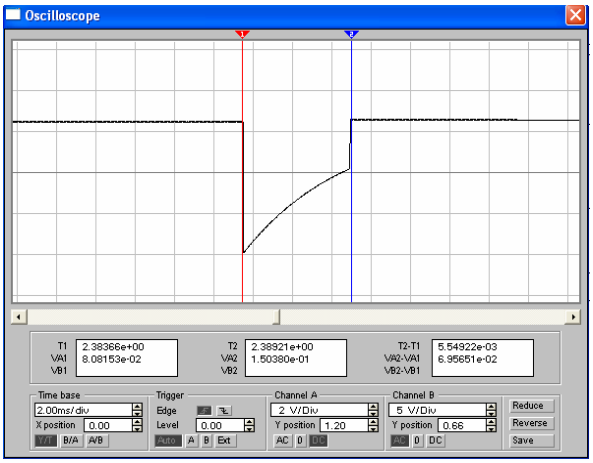

Fig.4. Show the characteristics out signal the circuit pacemaker indicated to pulse amplitude at 5.0 to 5.5 Volts with duration of 0.5 a 0.5 ms, to effect of producing the stimulation signal.

3.2. The test of circuit pacemaker.

The results obtained with pacemaker system were coherent with to simulate. The analysis in the mensurations show pulse amplitude is 4.89V and pulse width is 0.486 ms. whose graphics in the oscilloscope are presented in the Fig. 5. We can observe that the results in the simulated and testing pacemaker circuit indicate good correlation.

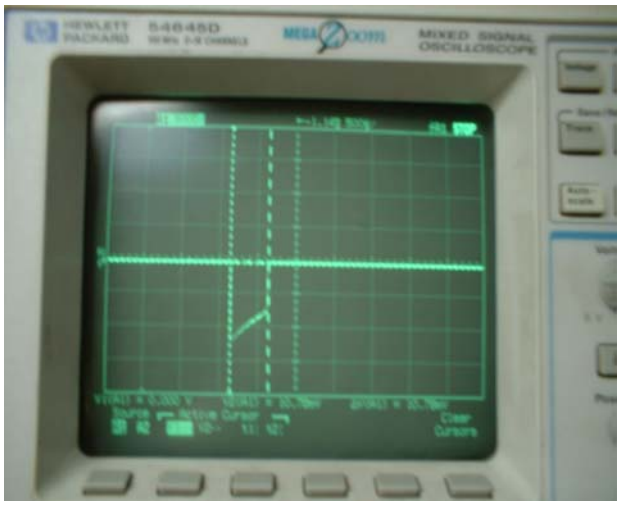

Fig.5. Graphics in the oscilloscope are presented the output pulses of circuit pacemaker; with correlation respect to simulate circuit. The analysis in the mensurations show pulse amplitude is 4.89V and pulse width is 0.486 ms.

3.3. The test of circuit pacemaker in patients.

The circuit pacemaker was proven under real conditions, where all the stimuli generated by the same one were detected, what constitute an important step in the validation the circuit. Fig. 6. Show the photograph the pacemaker system. Fig. 7 and Fig.8. Show the results in patient during the surgery in Military Hospital Center.

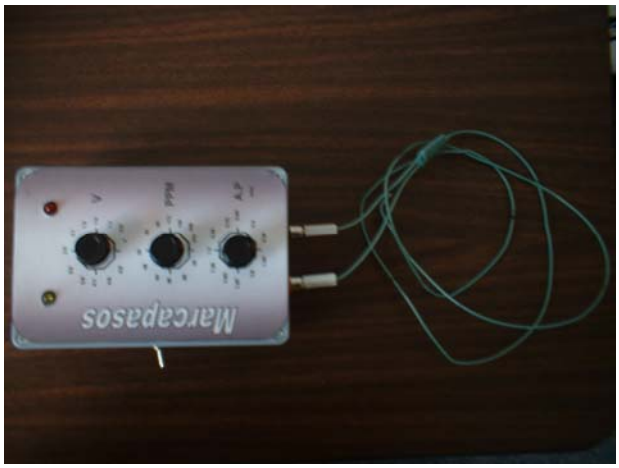

Fig. 6. The pacemaker circuit and electro cater.

Fig.7. Photographs the use of circuit pacemaker during the surgery in patient.

Fig.8. Results the EKG sign in patient as the use of external pacemaker. Blue color show the beats are marked for caused the stimulate circuit pacemaker and red color the normal beats among the vectors V1 to V6

IV. DISCUSSION AND CONCLUSIONS

The main goal of this paper is to show that electronic hardware design is a valid alternative to be taken into

account when deciding on the implementation of a certain development or the technical – economical possibility of a certain product in our context.

Many factors have contributed to the feasibility of the electronic hardware design in our country. The use of state of the art technologies is being made possible by the reduction in prototyping and production, fixed costs the affordable cost of powerful CAD stations and the simplicity of communications and access to information from providers and manufacturers, some examples of these techniques that they have been used in design and implementation the external pacemaker system.

A series of experiences done in recent in Military Hospital Center in Mexico are presented in this paper what was live and expressed in design circuit pacemakers.

The results obtained in this circuit confirm the proposed the development of external pacemaker they are used electronic circuit, the low price and high benefits existent in the Mexican National Market.

The statistical results between laboratory analysis and prototype show a direct dependence between both systems, considering measures in patients, the dispersion is elevated. This dispersion lowers if we consider homogeneous depending the particularly situation of the patient. This parameter can help to adjust the settings improvements the future design of pacemaker.

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