One Channel ECG System

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Abstract – **A simple one channel ECG system is described in the paper. A preamplifier and PC are included in the system. The real analog signals from the human body after amplification can be presented in real time using sound card of PC. It's possible to do different kind of computer treatment of ECG signals, also.The described systems is convinient for application in educational process.**

Keywords – **ECG system, computer treatment, education**

I. Theoretical Introduction

Since 1858 electrical activity has been associated with the contraction of the heart. Precise analysis of the nature of this phenomenon required the ability to measure very rapid changes in extremely small electrical potentials, which is possible with this device. It amplifies the bio-signals and measures them with ADC.

By software processing is possible the "zooming" in time, amplitude or both. It is also possible saving and sending the data through networks (local or world wide).

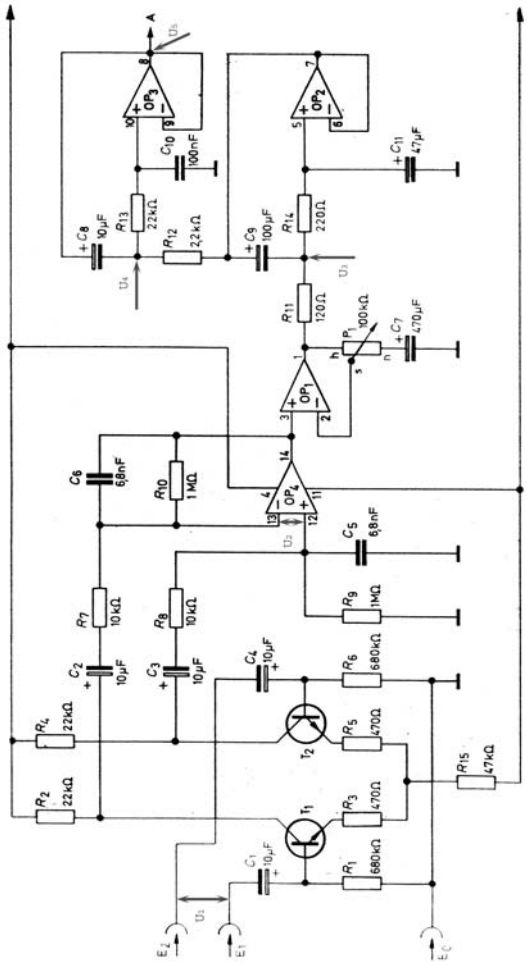
II. Tasks for the students

1. Recognation with the ECG system
2. Analyse of signals in the different points of the scheme /1,2,3,4,5 and 6/.

III. Practical Guide for Exercise

The preamp input block consists of differential amplifier which is built with the transistors T1 and T2 and the resistors R1 through R6 and R16 and capacitor C1 and C4. For better understanding we substitute that in the schematic the T1's base is positive input or E1 and the base of T2 – negative or E2. Through the rest of this text we will mark the ground electrode with E0. Capacitors C1 and C4 are used to ignore DC influence in the input stage. The input resistance is defined by the two resistors R1 and R6, which have high resistance.

The signal at the input of the transistor differential amplifier has level of 70-100 nV and it's form is shown at the first diagram from appendix A. The output signal has the same form as the input signal, but it's level is approx 5 mV (Fig. 2). The differential amplifier built with OP4 is used like selective amplifier suppressing high frequency signals (it's base



Sch. 1

amplification is 100 times), because of the connected it the connected at the loopback circuit capacitor which makes it deep for high frequency signals.

The next amplifier consists of OP1 allows the amplification of AC signals with amplification factor for 1 to 100. With the C7 mounting the amplification of DC generated by the zero drive of each operational amplifier is being suppressed for amplification by the next stages. This stage output's signal is shown at Fig. 3 at the appendix.

OP2 and OP3 are connected by Chebishev filterschematic with cut frequency approx 25 Hz. This stage rejects all signals with frequency over 25 Hz, including the power source embarrass (fig. 4 and 5 shows the decreasing (rejecting) of embarrass signals). The total amplification of the preamp is being regulated by potentiometer P1, and it can be regulated from 500 up to 40000 times.

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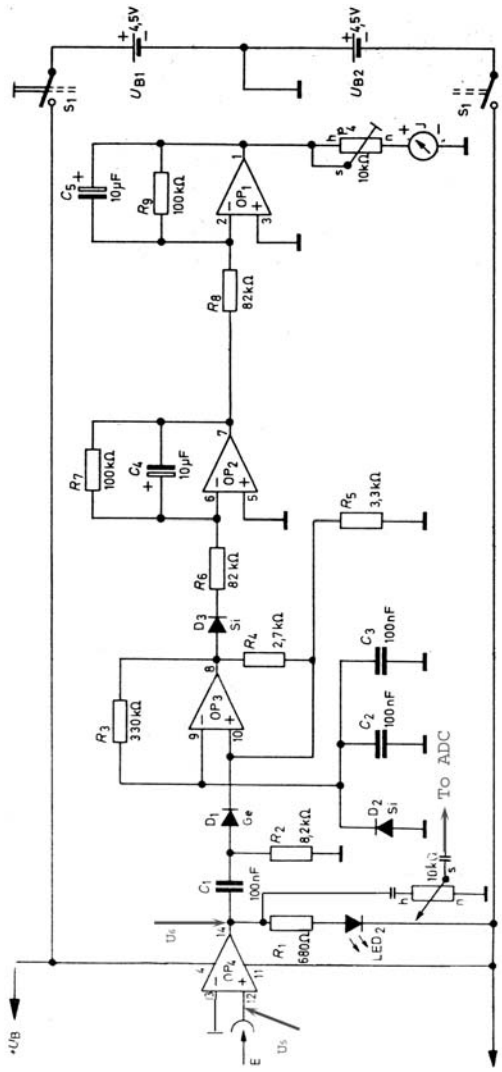

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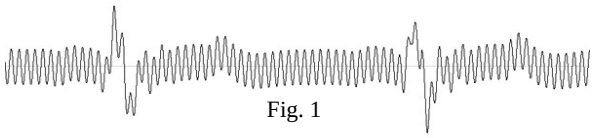


Fig. 1

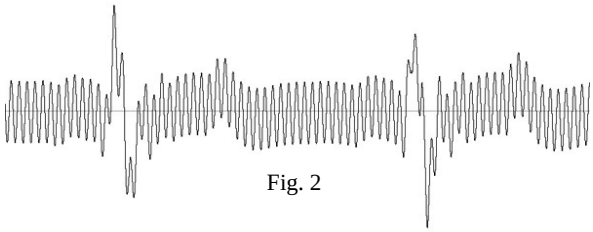


Fig. 2

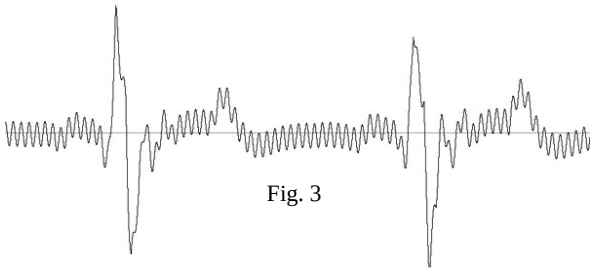


Fig. 3

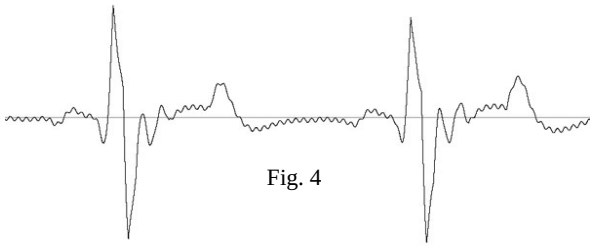


Fig. 4

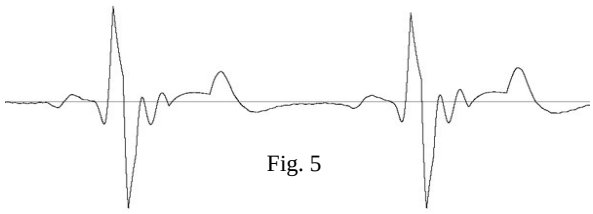


Fig. 5

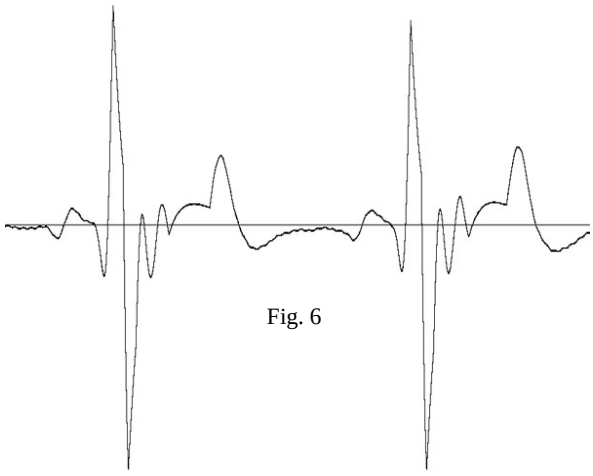
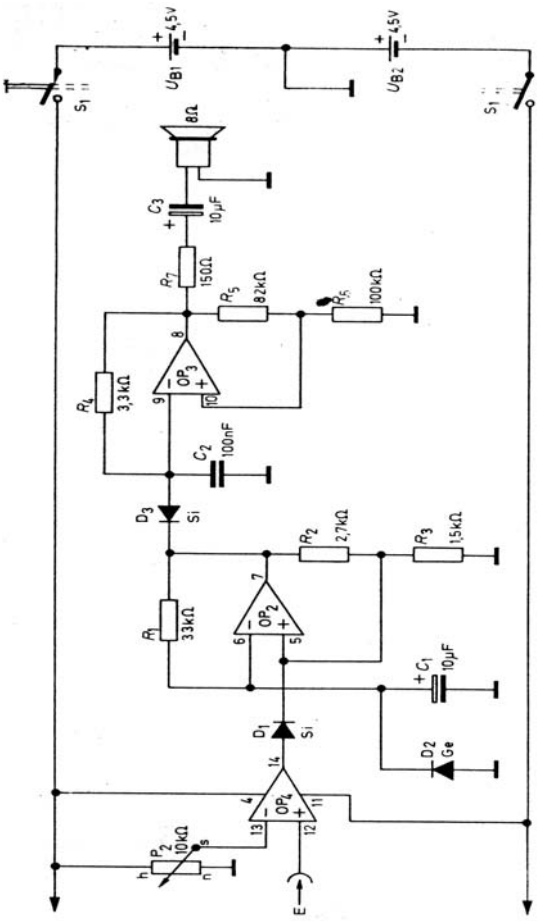


Fig. 6

The operational amplifier at sound signalization unit input is used like a comparator. At the one of it's inputs is connected P2, which provides support voltage, and the other input is being connected to preamp's output. The diode D1 passes only the positive part of comparator's output signal to the trigger connected after it. It is realized with OP2 and drives OP3 which is used like square pulse generator and it's output signal hears through speaker. For the driving is used mono vibrator built with OP2 and D3. If the signal at the comparator input is lower that the trigging threshold at the out put has negative voltage, D3 is opened and the generator cannot operate. If there is positive pulse at the input then at monovibrator's output has positive voltage, D3 is closed and the generator works. After the end of the pulse D3 again is closed and the generation stops.

At this scheme is made and visual pulse indicator and mechanical drawing device driving block. The input part of this stage consists of linear amplifier OP4 with amplification factor approx 100. The signal at it's output is the cardiogram (Fig. 6). This signal level can be regulated by potentiometer and can be digitized by ADC. The connected at it's output is connected LED, which is used to control triggers threshold level. The next two op amps are used to build driver stage for the mechanical drawer.



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IV. Conclusion

1. A simple ECG system, including PC was designed and described in the paper.
2. The ECG system can be used not only in medical practice but in engineering education also as practical exercise.

References

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