METHOD FOR DESIGN OF SYSTEM FOR MAGNETOTHERAPY USING "RUNNING"RANDOM LOW FREQUENCY SERIES OF SIGNALS

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Abstract

The systems for magnetotherapy, which use running low frequency magnetic field are new generation of systems for magnetotherapy. It is well known that familiarization of patients with parameters of external influence is a big disadvantage of systems for physiotherapy. This problem can be avoided in systems for low frequency magnetic field by running of this field around the human body. The possibility for simultaneously influence of low frequency magnetic field on different part of the human body is one additional advantage of systems for magnetotherapy, using moving magnetic field. The basic requirements and method for design of above mentioned system for magnetotherapy is described in the paper.

1. INTRODUCTION

The main component of systems for magnetotherapy using low frequency magnetic field is generator for rectangular electrical impulses with special parameters. Now more and more digital systems are applied to therapy. The use of digital elements for their construction offers greater flexibility, economy and more functions in one system. The data which pass through various digital modules can be saved in memory, subject to various digital processing, and also can be displayed on digital display. In the design of pulse generators can be used and one-chip microcomputers, characterized by low consumption and a limited number of external components. Great advantage over the basic generators is the programmable logic. Any functional change can be implemented easily without any hardware changes (making a new board, adding/replacing components).

2. THEORETICAL SOLUTION OF THE SYSTEM FOR MAGNETOTHERAPY BY RANDOM "RUNNING" MAGNETIC FIELD"

The system for magnetotherapy with the "running wave", the subject of this paper is achieved through a combination of analog and digital elements. Management system is implemented using a microprocessor PIC18F452 Microchip. The output of the processor signals are close to perfect form rectangular signals with extremely low and falling and rising edge amplitude of 5V. This allows for easy and extremely accurate control of analog components connected to the processor, as well as precise control of output signals for the system. The block diagram of the system for magnetotherapy by a "running" low frequency magnetic field is shown in Figure 1.

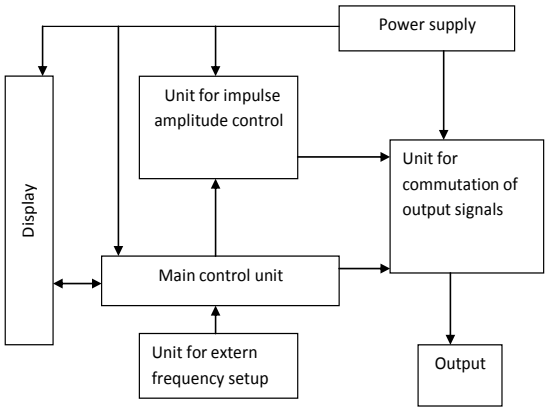

Fig.1 Bloc-diagram of systems for magnetotherapy with running magbetic field

The block diagram of the system for therapy by "running" magnetic field is mainly composed of seven functional blocks. Principle of operation of each of them will be discussed in detail below in the paper. Modes of therapy system can be described as follows: The output of the control unit generates a series of rectangular digital pulses that are submitted to "block for switching the output signals." Amplitude of the output is determined by the "control box for switching the amplitude of the pulse train." Management and operation mode of the system is possible through therapy, "Block external frequency control." For real-time visualization of the parame-

ters of output pulses for the system using liquid crystal display.

Fig. 2

The system can be build as apparatus for magnetotherapy which outputs are connected with many coils for local applications (Fig.2).

Fig. 3

The coils can be put on special medical bed for magnetotherapy, which has mobile carriage. A half of coils can be put on the bed and the rest coils cab put on the mobile carriage (Fig. 3).

3. BASIC COMPONENTS OF SYSTEM FOR MAGNETOTHERAPY BY "RUNNING MAGNETIC FIELD"

Control unit:

The control unit serves to control the behavior of the system, controlled by digital signals "block switching the amplitude of the pulse train", "block switching of output", "Block external frequency control." Powered by a microprocessor is pre-programmed with suitable software. This block sets: the time for generating periodic pulses, the maximum operating frequency, amplitude and rate of filling of the system output signals. Change the operating mode of this module is possible by detecting the signals coming from "external control unit of frequency." Modes of the block is monitored in real time by sending data to a digital liquid crystal display.

Because the requirements for the system required an appropriate program for proper and precise control of the synthesized sound. Created for this purpose is a program allows you to generate different delays and thus realize pulses with different frequency and duty cycle. Especially used for the system processor that is all one byte instructions are performed by a single instruction cycle. Exceptions are cases where there is a condition for branching in the program or the program counter changes its state following the instructions. In this situation, execution takes two instruction cycles, the second run by NOP /no operation/. Two-byte instructions are performed in two cycles, one cycle consists of four periods of the oscillator. Time for one command at frequency of 20 MHz clock generator is equal to 0.2s. In the presence of branching in the program or the program counter is changed as a result of the instructions, the time needed for implementation will be 0.4s. Therefore making delays of 1ms is necessary to make 5000 operatsii in the microprocessor.

The frequency of pulses at the terminals of microcomputer specified and outputs can be easily changed by appropriate subroutine. Manually changing the frequency via external buttons is also possible to realize the only way software. Providing this type of user control requires constant monitoring of the findings which relate buttons to change the status of signals.

One algorithm for implementation of this function is assigned to fig. 4. The block generating a pulsed output of a given frequency is a counter which counts up to a certain value. Thus, time-delay that occurs as a result of counting corresponds to the period of repetition of pulses. Before starting the count output, that which generates pulses with an initial level set "1" after counting to prevent that outcome again be reset, which in this case is a logical "0". Fig. 5 shows an example functional diagram of pulse generator realized with single-chip microcomputer. With two buttons, the user can adjust the frequency output of the device. The first button is used to increase the frequency and the

second reduction. The outputs of the microcomputer is applied the inputs for power circuit switching voltages and different target specific outputs of the synthesis apparatus.

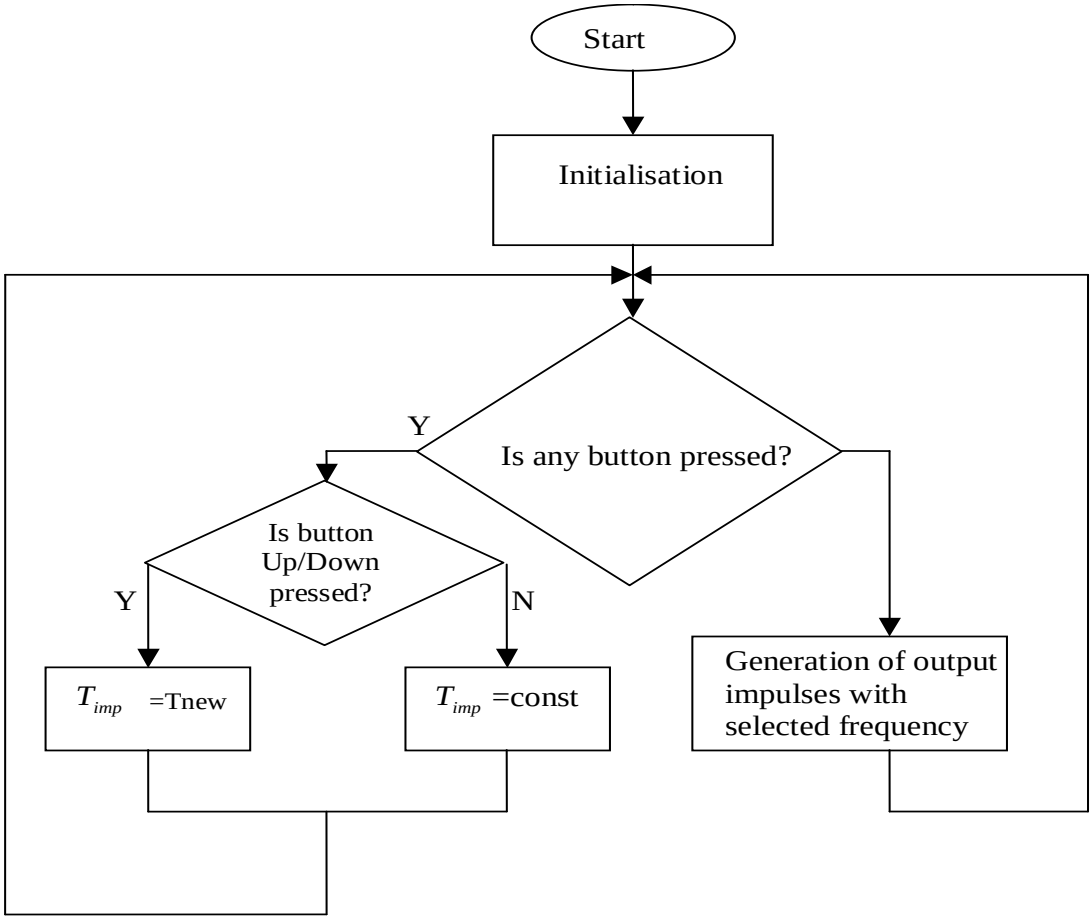

Fig. 4

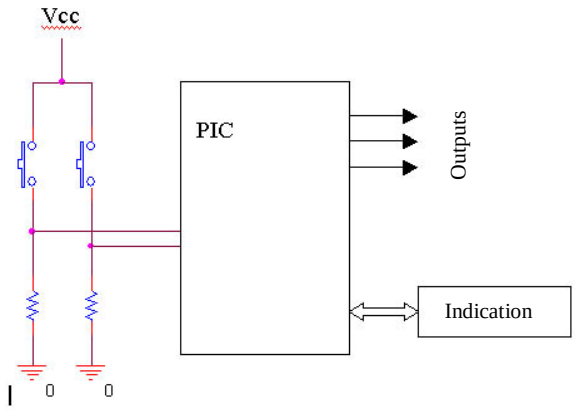

Fig. 5

The outputs of the microcomputer is applied the inputs for power circuit switching voltages and different target specific outputs of the synthesis apparatus. This is necessary because the outputs of the circuit can not provide the required output power and serve only as a logical control scheme. Providing feedback to the user device to be carried out by liquid crystal (LCD) also connected to the microprocessor. Thus it is possible to monitor the current frequency and amplitude of the output device. The successful combination of analog power components with micro-electronic integrated circuits offers a modern and easy way to precisely control, monitor and generate low-frequency analog signals with high power. The advantage of using such a combination consists of low power consumption and relatively simple hardware solution. Similar systems with traveling wave therapy in the manner described can be easily implemented in portable cans. By the user that makes the system convenient and easy to use.

External control unit of frequency

This block allows the user to influence the process of the system. By timing buttons displayed on the front of the device is easy to make changes in the parameters of the synthesized output signals for the system.

Block switching output

This unit carried out successively shift the generated pulse train to one of the outputs of the device.

Switching signal a "running wave" is done automatically using appropriate software solution. Principle of action can be explained by the fact that continuous time monitor which output is a logical unit. When an output is high level, all others are low. For the realization of a series of impulses running /"running wave"/ a walk therefore all conclusions in this case the duty cycle of pulses depends inversely on the number of outputs.

Control unit amplitude pulse train

Thanks to this unit it is possible to perform manipulation of amplitude output signal for the device. Provides precise control of amplitude of output signal for the system.

Output unit

Represents the synthesized output interface system. It consists of appropriately selected connector box mounted to the apparatus. Provides smooth and reliable connection between the device and external to the system inductive load.

Liquid-crystal display

Allows monitoring of pulse parameters and feedback from users. Visualization of the computer is deliberately avoided, because in this case functions, will be limited in the absence of a computer connected to projection device. Seven segment display is a good choice because of the need to use a large number of terminals to display a symbol. The ability to simultaneously monitor multiple parameters using a small number of conclusions and low power consumption due to the advantages that the use of the LCD-display the most appropriate choice.

Power supply

The power supply consists of a special transformer for medical equipment and a group of voltage straightening, maximum filtration and stabilization of the interference with the mains voltage. The main task of the unit to ensure proper working pressure of all the elements constituting the system. Input-output signals used for communication between management and individual blocks are:

- Power supply should work with the input output voltage ~220V/50Hz. Voltages of secondary windings usually must be 60,80,110 V AC.
- The output of power supply usually must be maintained straight and stable voltages +12 and +5 V. Used are voltage 7805 and 7812.
- Block external impact of the output signals chestotoa filed with TTL level / 0 and 5V inputs to certain microcomputer. After identification of the signals is done processing and software programming decision-making.
- By microcomputer management of hill-switch relays various secondary windings of power transformer. At precisely that moment in time, to an output device is made from selected AC voltage secondary winding of the transformer.
- To manage the unit is switching signals to TTL level to the microcomputer connected to it triacs. These signals serve to control the output signals and directing them to an exit. Provide mode "running magnetic field"
- Communication between the liquid crystal display and microcomputer is done by bus. It consists of a 4-bit data channel signal and 2 service configuration.

System therapy "running magnetic field" is synthesized by the successful combination of analog and digital components and appropriate software.

4. A REAL SYSTEM FOR MAGNETOTHERAPY BY "RUNNING" RANDOM LOW FREQUENCY MAGNETIC FIELD

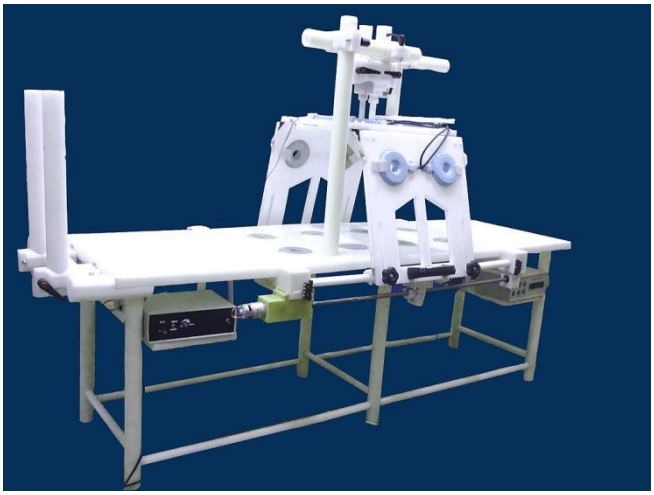

Fig. 6

A real system for magnetotherapy by "running" random low frequency magnetic field can be seen on Fig. 6. The outputs of apparatus for magnetotherapy are connected with five independent coils. The pulses of electrical current in the independents pairs of coils can be seen on fig. 7 It's possible to be provided not only "running " of magnetic field on the length of the bed ,but "rotation" of magnetic field, also. This rotation can be provided due to the coils situated on the mobile carriage.

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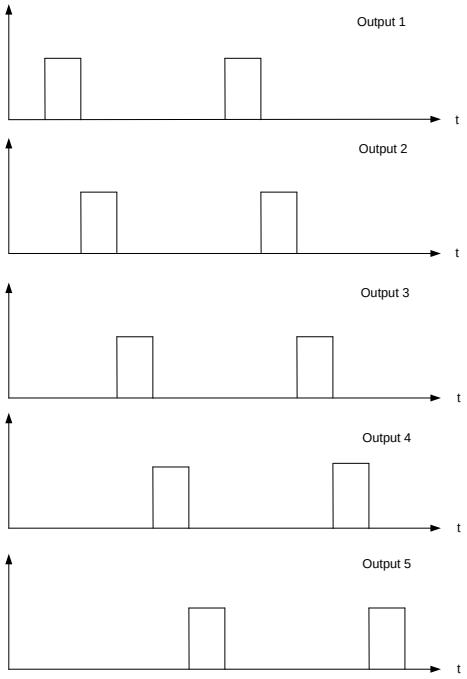

Fig. 7

5. CONCLUSION

1. A method and basic requirements for design of systems for magnetothearpy by running low frequency magnetic field are described in the paper.

2. A real system for magnetothearpy by running low frequency magnetic field is done , also/

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