DESIGN OF POWER UNIT OF SYSTEM FOR THERAPY USING "RUNNING" LOW FREQUENCY MAGNETIC FIELD

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Abstract

One very important problem in the process of design of systems for magnetotherapy is connected with design of power unit. 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 and especially design of power unit is described in the paper.

1. INTRODUCTION

The power unit should provide enough high amplitude of output current for all patients coils which are situated on the patient's bed (Fig. 1). The input signals of power unit are provided by 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.

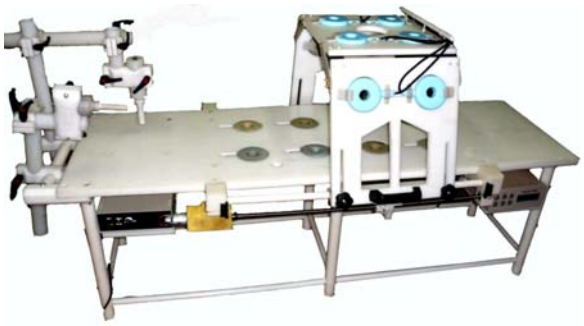

Fig. 1. Patient's bed

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. DESIGN OF POWER UNIT

To ensure the amplitude manipulation of the output signals device was used with sixteen transformer output voltage in the secondary coil. Managing stress how to manipulate the output signals of the apparatus at a time is done programmatically by way microprocessor management. In the production of the device is provided at the outlet to be used with a large inductive load inductance. Besides handling the voltage provided an opportunity to determine to which output is directed to output. For this switching are provided five separate and completely equal steps. This makes the device more versatile and easy to use and "animation" as-entitling the choice of the designer to choose which output to use enhancements. Given the characteristics of the inductive load for the apparatus final steps are realized by choosing powerful triacs. The use of transistor stages is not desirable because the application of inductive load is observed instability in their work.Powerful Hill-relays are characterized by a finite number of switch and losses caused by mechanical contact of the switch plates, large switching time, high cost and risk of injury. Given the stable operation of the triacs work with inductive load, low market price, compact size and good working parameter's hoice for the thesis is the most appropriate. For the final steps is possible to conduct high currents up to 3A and relatively high voltage 24V. Used triacs model BTA12-600B. They are characterized by low current opening 50mA, 12A maximum current in the control circuit and

600V maximum voltage. Repeatedly higher characteristics of triacs to set in the assignment of work provide more reliable operation of the elements and less waste heat process. Used Six triacs (Q12-Q17) for the amplitude manipulation provided with six and five strains (Q18-Q22) to provide switching and management outcome of five sets.

The maximum of output current signal from the microprocessor is 25mA. The use of such power will not be enough to clear a triacs, and will also lead to strong and increase of temperature of microprocessor. Ensuring adequate power to clear triacs, and also the simplification of the CPU is achieved through the use of transistor stages placed between the ruling and findings of the microcomputer gates of triacs. Transistors are connected in a circuit common collector (emitter repeater). For this type of scheme is characterized by low voltage amplifier, high gain in current and power. Depending on the given signal on the basis they operate in standby mode or route of saturation. The maximal current for the gate triacs in a performance is 50mA. Therefore, to ensure reliable and stable operation of transistor stages are designed for currents less than 50mA.

$$Ic_{max}=V_{cc}/R_e=>$$

$$Re=V_{cc}/Ic_{max}=12/40.10^{-3}= 300ohm$$

A medium power transistor model 2T6551can be used.It can be seen using output transistor's parameters that collector current would be 40mA, wich corresponds to the base current 2mA. The emitter's current which is an input to the gate of triac is the sum of the collector and base current of transistor and it's less than the maximum of triac's current. The diagram of power unit is shown on Fig. 2.

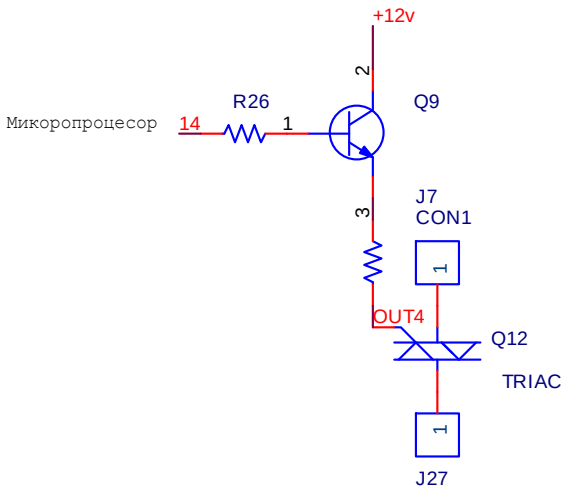

Fig. 2. The diagram of power unit

To achieve simultaneous amplitude manipulation of the output current and switching output, switching voltages of triacs are connected in series to the triacs switching outputs. In this case the output inductive load is to be connected in series between the two triacs. This is shown in the diagram on Fig. 3. The connectors (j7-j12) relate the findings of the secondary coils of different voltages of the transformer.

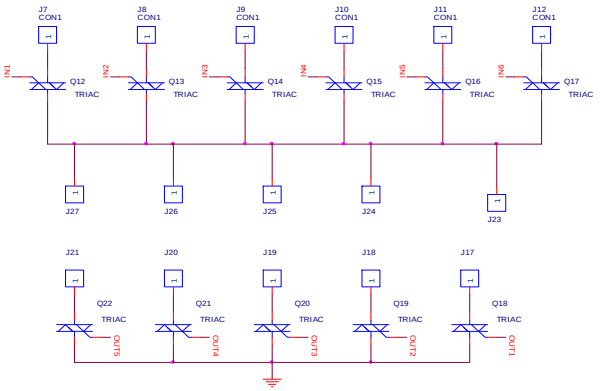

Fig. 3. The diagram of power system

As first step a load should be placed on the output of the generator. It's necessary to be provided signal to the gate of one of the triacs (Q12-Q17) which is chosen for what will be output amplitude signals. The circuit of the transformer secondary winding is closed only when given the signal to one and triacs (Q18-Q22) and a connection through the load during the triacs to the table. The used software provide that in every time only one triac from the group Q12-Q17 is open and only one triac from the group Q18-Q22 is open. The rest triacs are closed in the same time. For all solid steps are observed similar features so that all elements used in transistor stages are the same. Same are also all triacs used in the generator. Ensuring a stable constant tension, which determines the work mode for operation of the constituent elements of the generatot is designed using classical stabilizer circuit. AC input voltage of the transformer first face of the scheme Greeks, smoothes then be submitted to the stabilizers IS 7812 and IS 7805 for precise stabilization.

3. DESIGN OF PHYSICAL COMMUNICATION BETWEEN MICROPROCESSOR AND IT'S MANAGED MODULES

The management of multifunctional pulse generator is fully implemented using a microcomputer. It has 25 input / Exit buffers organized as follows:

- Four inputs - for providing a possibility of external influence on the generated frequency;
- Five output provided for switching and control signals to the output device;
- Six exits down switching voltage secondary winding of the transforme;.
- One output to generate a beep;
- Six concludes the realization of communication with liquid crystal display
- Three input/output for providing communication with an integrated I2C Clock IC PCF8583.

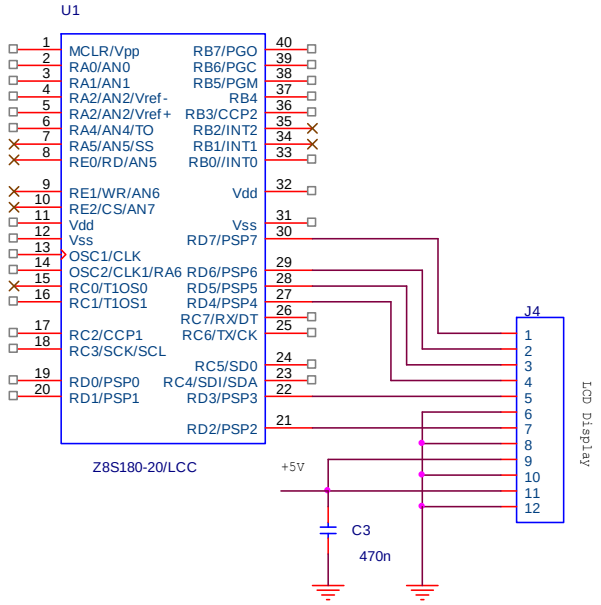

Fig. 4. The principal linked diagram to a microcomputer

The principal linked diagram to a microcomputer is shown on Fig. 4. Four bit interface is used for communication with the display. This facilitates the realization of the projected hardware enhancements. The disadvantage is you will be sent information on two cycles and shipment process is slower than when using an 8-bit interface. In the design process was identified from this will not affect the accuracy of the work unit. Use the findings of the microcomputer are:

– RD2 – to R / S switch between registry data and commands

– RD3 – as at R / W switch mode read or write mode

– RD4–RD7 – inputs for information exchange.

Management unit switching voltage is realized by using six concludes the microprocessor configured as outputs. These are:

- Conclusion RA1 - switching voltage of 9V
- Conclusion RA2 - switching voltage of 12V
- Conclusion RA3 - switching voltage of 15V
- Conclusion RA4 - switching voltage of 18V
- Conclusion RD0 - switching voltage of 21V
- Conclusion RD1 - switching voltage of 24V

Management unit switching output is realized using five concludes the microprocessor configured as outputs:

- Conclusion RC1 - for switching output 1
- Conclusion RC2 - for switching output 2
- Conclusion RC5 - for switching output 3
- Conclusion RC6 - for switching output 4
- Conclusion RC7 - for switching output 5

Communication between the microprocessor PcF8583 and integrated circuit is implemented in I2C interface. He held the following conclusions of microprocessora:

- Conclusion RC3 - Seril clock-submission of a series of clock pulses to the circuit
- Conclusion RC4 - Seril DATA-submission of information by serial clock pulses to the circuit
- Conclusion RB0/INT0 – adopting external breaks. Receiving signals from integral circuit.

User intervention in the operation of a microcomputer is implemented with the help of four buttons. They are connected to the four outlets of the CPU and are configured as outputs. These are:

– RB7 – serving to stop / pause / procedure for generating a periodic pulse train and entry menu is setting the parameters of the generated signals

– RB6 – served to start / continue the procedure of generating a periodic pulse sequences / store the changes made by the user.

– RB5 – serves to increase the frequency / time / duty cycle of the pulse sequences / voltage output. Switching from automatic to manual mode to change the frequency of pulse outputs

– RB4 – serves to reduce the frequency / time / duty cycle of the pulse sequences / voltage output. Switching from automatic to manual mode to change the frequency of output pulses.

To make an audible alarm is used piezoelectric buzzer. It is connected to terminal RB0 na microprocessor in limiting resistor to ground

4. CONCLUSION

A new method for design of power unit of system for therapy using "running" low frequency magnetic field is done in the paper.

Acknowledgments

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