United States Patent

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[33] **Sweden**
[31] **14742/66**

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[54] **CARDIAC SOUND SIMULATOR**
3 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **128/1;** 46/232; 331/113
[51] **Int. Cl.** **A61b 19/00**
[50] **Field of Search** 128/1, 1.03; 119/1; 46/232; 331/113

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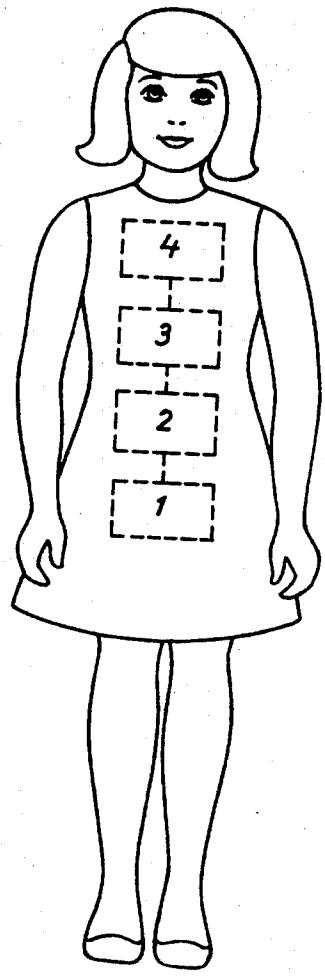
ABSTRACT: Incorporated within a toy is a cardiac sound simulator. The simulator comprises a pulse generator which generates pulses in pairs. The time between the pulses in each pair being less than the time between pairs and the two pulses of a pair having different time durations. The pulses are fed to a loudspeaker which converts the pulses to a sound having the rhythm of a heartbeat.



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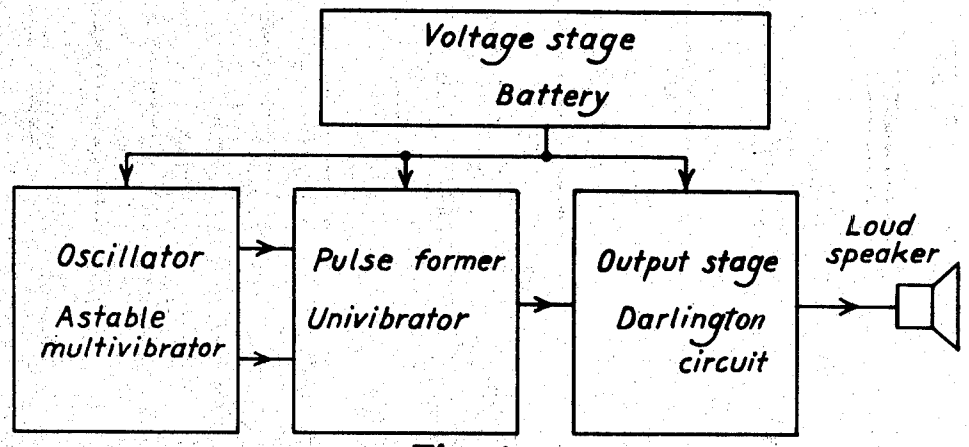

Fig. 1

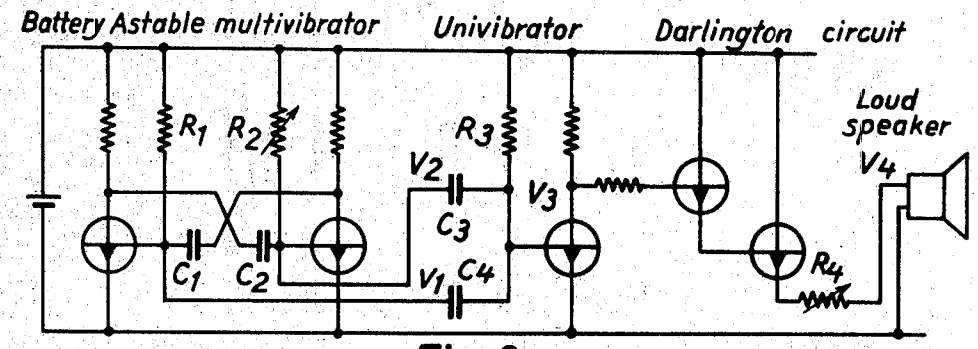

Fig. 2a

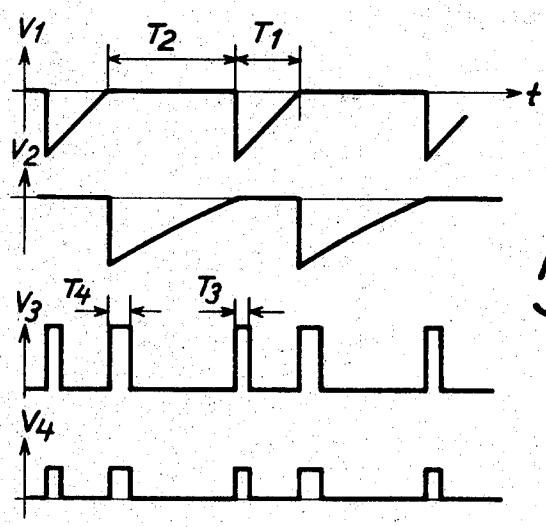

Fig. 2b

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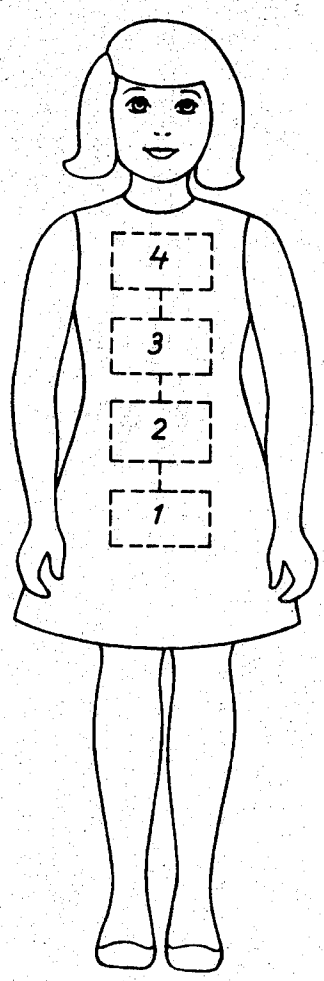

Fig. 3

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CARDIAC SOUND SIMULATOR

The present invention relates to a toy in which is built in a double pulse generator for producing cardiac sounds (heart sounds).

It is known that a child can perceive sounds from a heart and also can distinguish nuances. A certain cardiac sound (very likely with a low frequency) acts soothingly. About this L & M Milne writes the following on page 46 of the book: "The Senses of Animals and Men."

"Does a human baby listen to its mother before birth ? Recently, linguists have wondered about the lub-dupp, lub-dupp, lub-dupp from the mother's heartbeat. Primitive languages are full of repeat-syllabled words, comparable to familiar baby talk: da-da, ma-ma, gee-gee. Perhaps we are born with a strong preference for sounds in pairs, imitating the comforting sequence heard in the womb.

When you come to think about it, you realize that in most human societies a baby has a chance to listen to its mother's heart after birth too. She holds the child in her arms with its ear pressed against her chest, or she protects it under her blanket on her back, with its ear flattened against her skin between her shoulder blades. Surely the baby can hear as well as a doctor with a stethoscope cupped against these areas. We may yet discover an importance for a mother's heart sounds in the normal development of the child.

The soft lub-dupp, lub-dupp of a relaxed mother's heartbeat was played recently over the loudspeaker system into a nursery room full of newborn babies. Outside the big picture window, a hospital technician with a clipboard kept a tally on the youngsters in the bassinets. Most of them soon went off to sleep. The rest appeared reasonably contented. The recording stopped. Within a few seconds a good many babies woke up; some began to cry. Then a new record was played: the rapid heartbeat from an excited woman. The sound was no louder, but all of the sleeping babies awoke immediately. Every infant grew tense, as though in fear. When the first recording was played again peace spread through the nursery. Are its mother's heartbeat sounds a baby's first mood music ? "

An object of the invention is to provide an arrangement that can be used for purely medical purposes and for making toys more lifelike whereby a toy provided with the arrangement can be used for medical purposes.

The invention will be described below with reference to the accompanying drawing on which FIG. 1 is a block diagram of a sound generator, FIG. 2*a* is a circuit diagram of such a generator, FIG. 2*b* is a diagram of the voltages V_1—V_4 as a function of time and said generator, and FIG. 3 shows the generator mounted in a doll.

The cardiac sound simulator consists of a double-pulse generator which runs a miniature load speaker, and is intended to be mounted in dolls, animals and similar toys.

As appears from the introduction, investigations have been made which prove that there is a connection between external heart sounds and the mental condition of small children. Thus it has been found that when a child listens to calm heart sounds, it will be comfortable in its mind and falls asleep while the child wakes up showing obvious signs of anxiety if the heart sound grows louder or is more rapid.

By mounting a simulator according to the present invention in the toy animal or in the doll that the child is in the habit of having in bed, the result can be achieved that a child having difficulty in relaxing will listen to the regularly beating heart of the doll and thanks to that it will be appeased and falls asleep.

Besides that the simulator possesses certain soothing properties, it gives also the toy in which it is mounted an illusion of life, which in its turn makes the toy in question more attractive.

The frequency spectrum can be varied because the duration of the two pulses and the duration of the intermediate spaces can be varied within wide limits. These periods are determined by time constants (RC) in the generator. Thanks to the design of the transistor the wear and tear is small and the consumption of current will be low. A prototype with the following periods (see FIG. 2) has been built: $T_1 = 0{,}12\ s$, $T_2 = 1s$, $T_3 = 3$ *ms*, $T_4 = 10$ *ms*. A decrease of the operating voltage from 4.5 v. to 3 v. did not change the frequency audibly. When adjusting the sound intensity so that it was comparable to the ticking of an alarm clock, the consumption of current was about 2ma.

The block diagram of FIG. 1 shows the principle of the construction. The voltage unit is composed of a flashlight battery. An oscillator consisting of an astable multivibrator delivers 2 pulses per period. The pulses start with a transient and are turned into an exponential function. The pulses give sounds, substantially at the time of the transient. The exponential function is long and would demand a very great effective power if this should run the loud speaker. The power that can be converted into sound, is small. The pulse may therefore first pass to a pulse former of the univibrator type. For each transient appearing on one of the inputs of the univibrator, a short square pulse is delivered on the output. The square pulses are amplified in an output stage of a Darlington circuit and pass through the sound control to the loud speaker where they are transformed into sound.

FIG. 2*a* shows an example of a circuit diagram, and FIG. 2*b* the waveforms of the voltages at four different points in the circuit. The pulses from the astable multivibrator are selected on the bases of the transistors. They are reproduced in the diagrams $V_1 = f(t)$ and $V_2 = f(t)$. The periods T_1 and T_2 are determined by the time constants R_1, C_1 and R_2, C_2 respectively. The negative transients trigger the univibrator. In this case the transistor current will be interrupted for a time (T_3 or T_4) determined by C_3, C_4 and R_3. During this time the collector voltage V_3 will rise. This generates a positive pulse which passes to the Darlington circuit. This circuit has a high input impedance and a low output impedance. The voltage amplification is less than 1 (see $V_4 = f(t)$, but because of the high current amplification the power amplification will also be high. The potentiometer connected in series with the loud speaker serves as volume control.

Other embodiments than that one described here can be regarded. The generator can be built very much simpler and in a smaller size but the price will then be higher. For example, a unijunction transistor can be used in the oscillator and a tunnel diode in the pulse former. Integrated circuits can also be considered. Button cells can replace the flashlight battery.

As a modification of the invention a crystal loud speaker is used instead of a loud speaker of the dynamic type, which is the case in the embodiment described above. By using a crystal loudspeaker the loading effect can be decreased to approximately one-fiftieth in comparison with dynamic loud speakers. A crystal loudspeaker has, however, a somewhat inferior sound quality, which in this case is of no importance.

In order to make it possible to use crystal loud speakers the circuit must be changed for example in the following manner: (See FIG. 2*a*). The univibrator, the Darlington circuit and the dynamic loud speaker are omitted. The crystal loud speaker is connected to the collectors of the transistors in the astable multivibrator.

In the embodiment of the invention shown in FIG. 3 the sound generator is built into a doll. A voltage source 1 supplies voltage through a switch 2, enabling the generator 3 to be connected or disconnected to the voltage source 1 (battery). The sound pulses are produced in a loud speaker 4.

I claim:

1. A toy comprising:

at least a body portion;

a sound generator within said body portion; said sound generator comprising pulse generating means for periodically generating pairs of electrical pulses, wherein the first occurring pulse of each pair has a shorter time duration than the second occurring pulse of said pair and the time between pulses of each pair being less than the time between adjacent pairs of pulses;

said pulse generating means comprising a free-running astable and asymmetrical multivibrator having first and second outputs wherein said first output transmits a first train of pulses having a given time duration and said

second output transmits a second train of pulses, complementary to said first train of pulses, and having a time duration greater than said given time duration;

a univibrator having first and second inputs connected to said first and second outputs, respectively, of said multivibrator for receiving said first and second trains of pulses simultaneously, said univibrator generating a pulse in response to each received pulse, the duration of each generated pulse being equal to the time between the leading edge of a received pulse and a particular point on the trailing edge of said received pulse; and

transducer means receiving said electrical pulses for emitting sounds occurring at the leading and trailing edges of said pulses so that the sounds occurring in response to one pulse of the pair are heard as a sound with a first tone and the sounds occurring in response to the other pulse of the pair are heard as a sound with a second tone different from said first tone.

2. The toy of claim 1 wherein the pulses of said first and second trains of pulses have a sawtooth shape and the pulses generated by said univibrator have durations equal to the time between one of the edges of a received pulse and the time when the other edge of said received pulse has a given signal level so that the pulses generated by said univibrator in response to the received first train of pulses have a different time duration than the pulses generated by said univibrator in response to the received second train of pulses.

3. The toy of claim 2 wherein said transducer means comprises an amplifier having a high input impedance and a low output impedance, a loudspeaker connected to the output of said amplifier and means for connecting the input of said amplifier to the output of said univibrator.