Electronic Foetal heart Simulator

This invention relates to the electronic foetal heart simulator.

Monitoring of the foetal heart is extremely important both before and during labour, it provides clinicians with essential data relating to the wellbeing of the unborn baby. This data is used as a tool in aiding the clinicians in their decision making process regarding the physiological condition of the baby. The information obtained may indicate amongst other things the necessity for surgical intervention in the form of caesarian section if the baby shows signs of hypoxia.

Ultrasonic foetal monitors have evolved to provide this facility and are now used extensively in hospitals throughout the world. This type of monitor uses sound waves in the ultrasonic spectrum to derive the foetal heart rate from the physical heart wall movement. The technique entails directing a beam of ultrasound produced via a transducer through the mothers abdomen towards the foetal heart, this beam is deflected off the moving heart wall, which causes a doppler shift in frequency. The returning beam is received by the monitors transducer and presented to the processing electronics of the foetal monitor, where the doppler shift is detected, and manipulated to produce a signal corresponding to the foetal heart rate. The heart rate is then displayed on a numeric display and also on some monitors on a paper chart recorder. An important parameter also displayed by the latter is the foetal heart accelerations and decelerations, which provide an indication of foetal distress.

The correct operation of these monitors is of paramount importance and hence a reliable and accurate method for testing them was needed. The main problem of testing these monitors, was the requirement to produce controllable simulated heart wall movements and a means of coupling these movements ultrasonically to the monitors transducer. This can be accomplished by the construction of a foetal heart simulator , whereby the monitors transducer is coupled to the simulator using a standard coupling gel, the simulator then providing the necessary heart wall movements and sound via an appropriate electronic movement transducer, coupling medium and electronic control system.

According to the present invention, there is provided an electronic foetal heart simulator comprising a main simulator body filled with a suitable medium within which is embedded an electronic device to simulate the movement of a Foetal heart wall, and a means for electronic connection to be made to external control electronics.

A full component and technical description follows with reference to figure 1.

The electronic foetal heart simulator. consists of the following component parts see (figure 1). A main simulator body(1) with access hole(2) for connecting cables(3), electronic movement

transducer(4) and suitable coupling and embedding material(5) to enable ultrasonic attenuation and coupling.

Referring to figure(2), the following describes the operation of the electronic foetal heart simulator.

Ultrasonic waves from the Foetal Monitor (6) pass via it's transducer(7),through the commercially available coupling medium(8), then pass through the main simulator body(1), and after being attenuated by, and passing through the suitable coupling and embedding material(5), are deflected by the electronic movement transducer(4) which being activated by drive and control electronics, produces a movement within the coupling and embedding material. This movement causes a doppler effect upon the signal transmitted by the Foetal
monitor under test. This signal is then filtered, analysed and displayed by the Foetal Monitor under test.

A Specific embodiment of the invention will now be described by way of an example with reference to fig 3:-

Figure 3 shows a Foetal monitor(6) being tested by the electronic foetal heart simulator which is connected to accompanying processing and drive electronics (9). The Foetal monitor produces an ultrasound signal via crystals embedded within an enclosed housing (7). This signal, typically 2mhz, is coupled via the commercially available medium (8) to the main simulator body (1). After passing through the main simulator body (1), the signal is attenuated by, and passes through the coupling and embedding material (5). Some of the signal is reflected by the change in medium caused by the presence of the electronic movement transducer (4), and some is reflected by the presence of the main simulator body (1). When the electronic movement transducer (4) is static, the signal received by the foetal monitor via the housing (7) contains no Doppler shift component, and hence when the carrier frequency is removed by the foetal monitor, no foetal information is present. A complex electronic signal of similar frequency spectrum to that of a foetal pulse is produced by the micro-processor (11), and the D/A network (12) this is passed through the controllable signal attenuator (13)to the summer(18), and then through the power driver (14). This signal produces movement of the electronic movement transducer(4). This movement causes a doppler effect upon the signal produced by the housing (7), which when processed by the foetal monitor (6) causes the foetal monitor (6) to respond by displaying a pulse rate equal to that set up by the micro-processor (11). The processing and drive
electronics (9) can also be programmed such that the pulse rate presented to the electronic movement transducer (4) can be altered with respect to time producing an acceleration or deceleration in pulse rate which can confirm the specifications of the foetal monitor(6). An additional signal produced by the microprocessor (11) and D/A network(16) passes through controllable signal attenuator (17) and may be summed at the summing point(18), simulating all physiological conditions experienced by a fetus. By use of the attenuator (13) and the microprocessor (11) many variations in signal amplitude and shape can be converted into movement by the electronic movement transducer(4), thus the foetal monitor (6) can be made to display information equating to many problems associated with an abnormal fetus.

claims

1. An electronic foetal heart simulator. Consisting of a main simulator body containing an electronic movement transducer and suitable coupling and embedding material. The electronic movement transducer being encased within the coupling and embedding material.

2. An electronic foetal heart simulator as claimed in claim 1, wherein a means is provided via the electronic movement transducer as claimed in claim 1 to produce a movement within a suitable coupling and embedding material

3. An electronic foetal heart simulator as claimed in claim 1, wherein a means is provided via a suitable coupling and embedding material, as claimed in claim 1 to provide a coupling medium.

4. An electronic foetal heart simulator as claimed in claim 1 wherein a means is provided via a main simulator body as claimed in claim 1 to enclose the suitable coupling and embedding material as claimed in claim 1, and the electronic movement transducer as claimed in claim 1.

5. An electronic foetal heart simulator as claimed in all previous claims 1 to 4 inclusive, wherein a means is provided to simulate the physiological response of a foetal heart when undergoing those tests by ultrasonic means that determine the pulse rate, acceleration rate, and any other information necessarily required by a foetal monitor.

6. An electronic foetal heart simulator as described herein with reference to figures 1 to 3 inclusive.

ABSTRACT

Electronic foetal heart simulator

An electronic foetal heart simulator consisting of a main simulator body ,an electronic movement transducer, a suitable coupling and embedding material and electrical connectors connecting the electronic movement transducer to external electronic control. Electrical signals are fed to the electronic movement transducer, and are converted to sympathetic mechanical movements of this device. These movements when coupled via the coupling and embedding material and main simulator body to the foetal monitor ultrasound head produce a doppler effect upon the foetal monitor transmitted signal which is interpreted as valid data as though from a human fetus.

figure 1

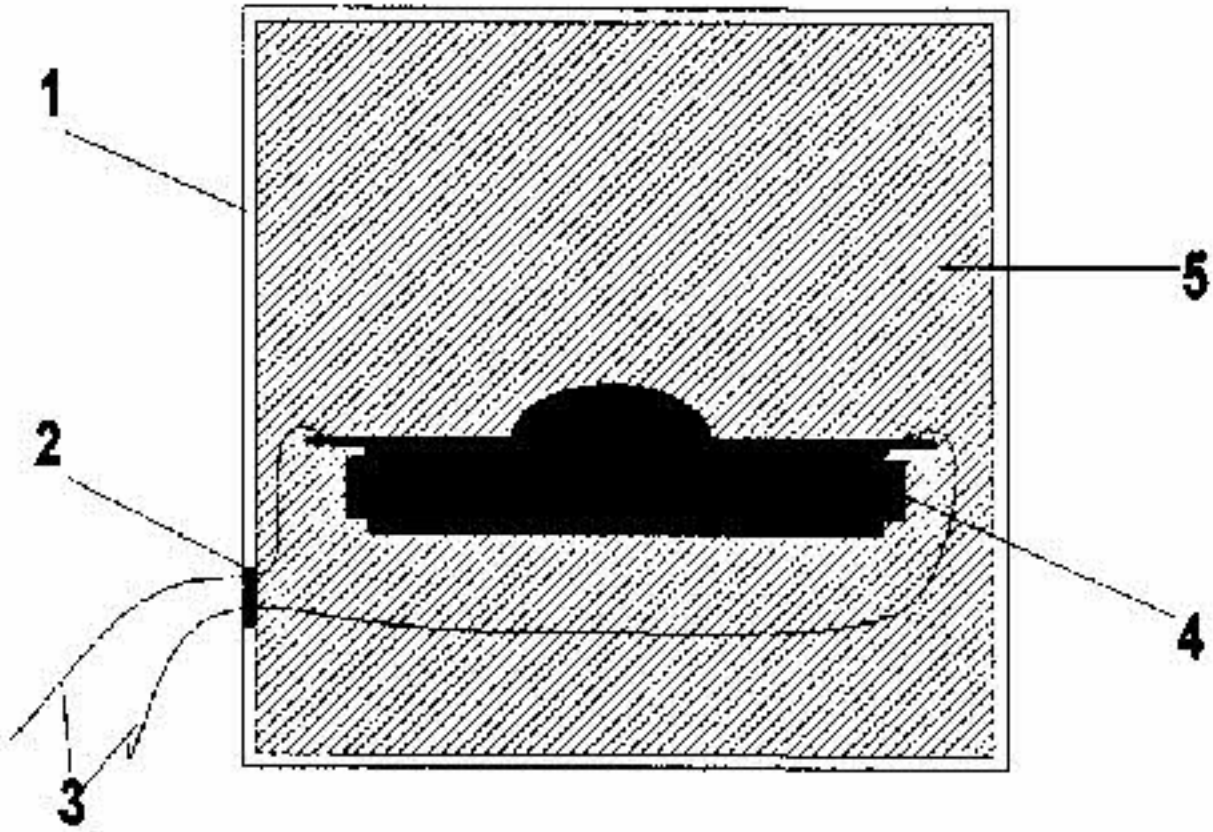

figure 2

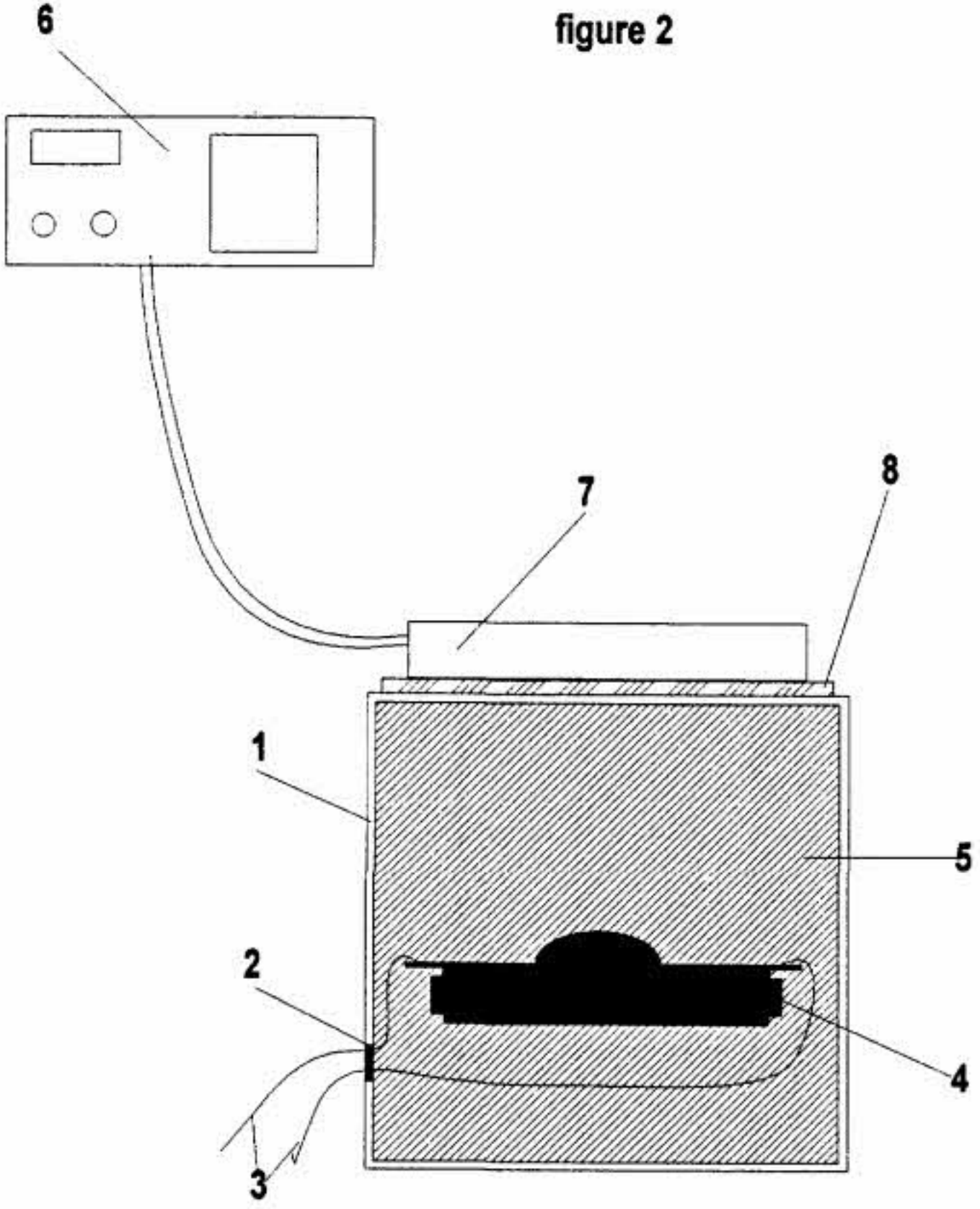

figure 3