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GB 2270000 A **GB 2188238 A** **EP 0145173 A1**

(58) Field of Search
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(54) **Synchronised electro-magnetic therapy device**

(57) An electro-magnetic therapy device for treating a variety of conditions or traumas of a subject P, comprises a coil 13 for application to the subject, a control unit 10 for supplying electrical pulses to the coil, and a sensor 12 for application to the subject to sense a rhythmic function of the subject's body, and serving to synchronise the electrical pulses supplied to the coil. Conveniently, the sensor 12 may be secured to the subject's finger, for example, to sense the subject's blood flow pulses, to supply the electrical pulses to the coil 13 at the peaks of these blood flow pulses.

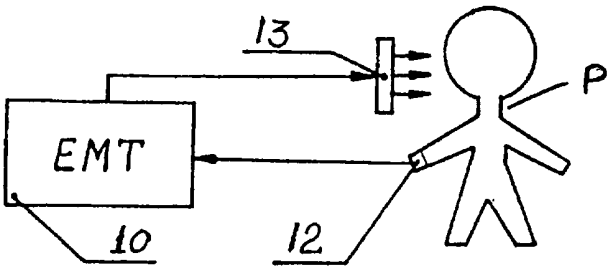

Figure 1

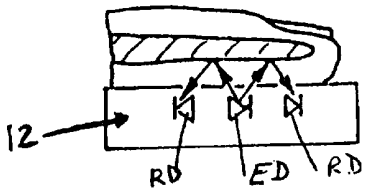

Figure 2

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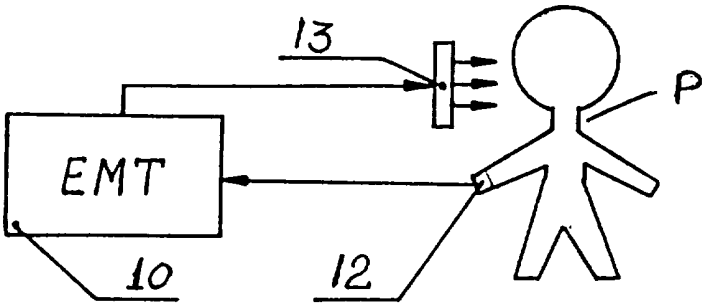

Figure 1

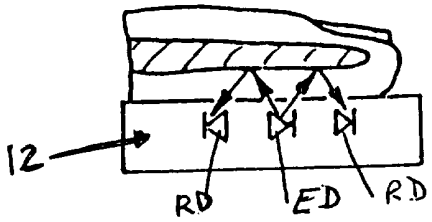

Figure 2

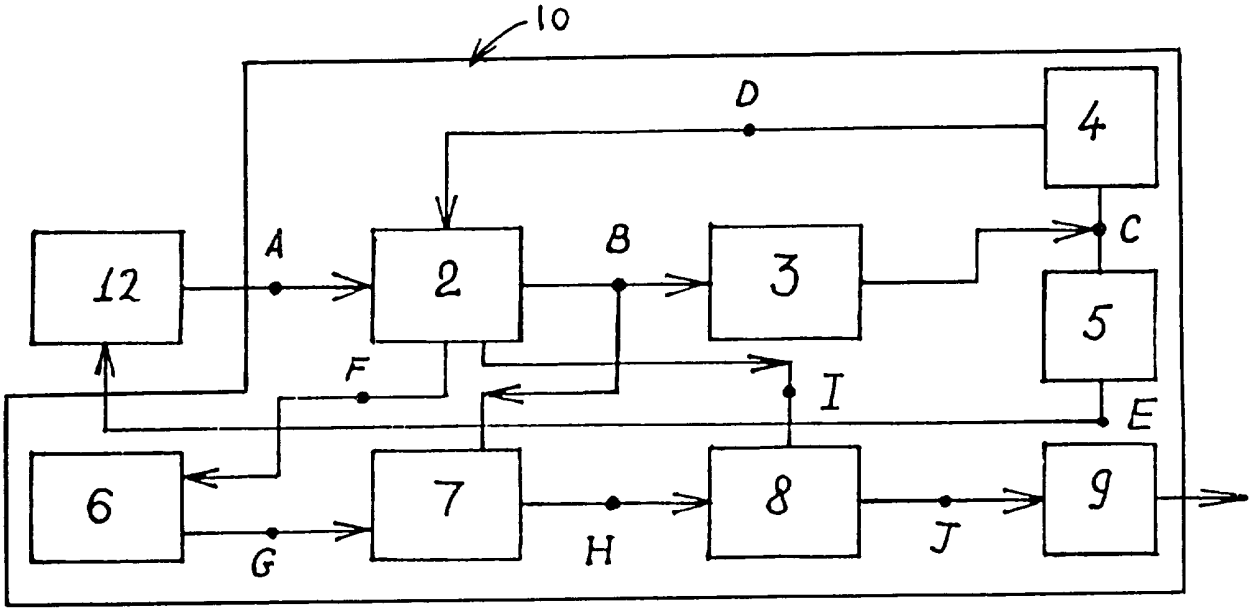

Figure 3

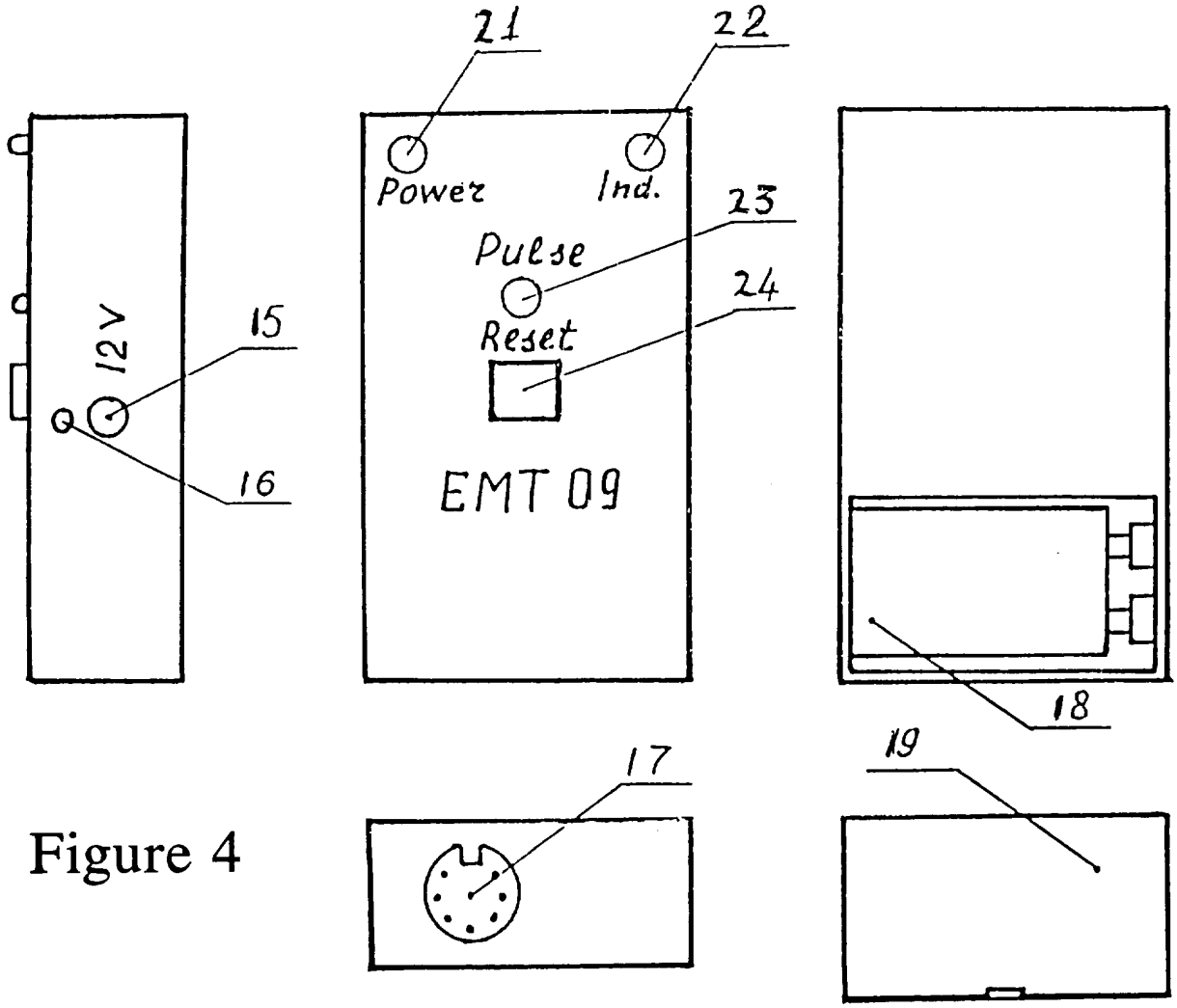

Figure 4

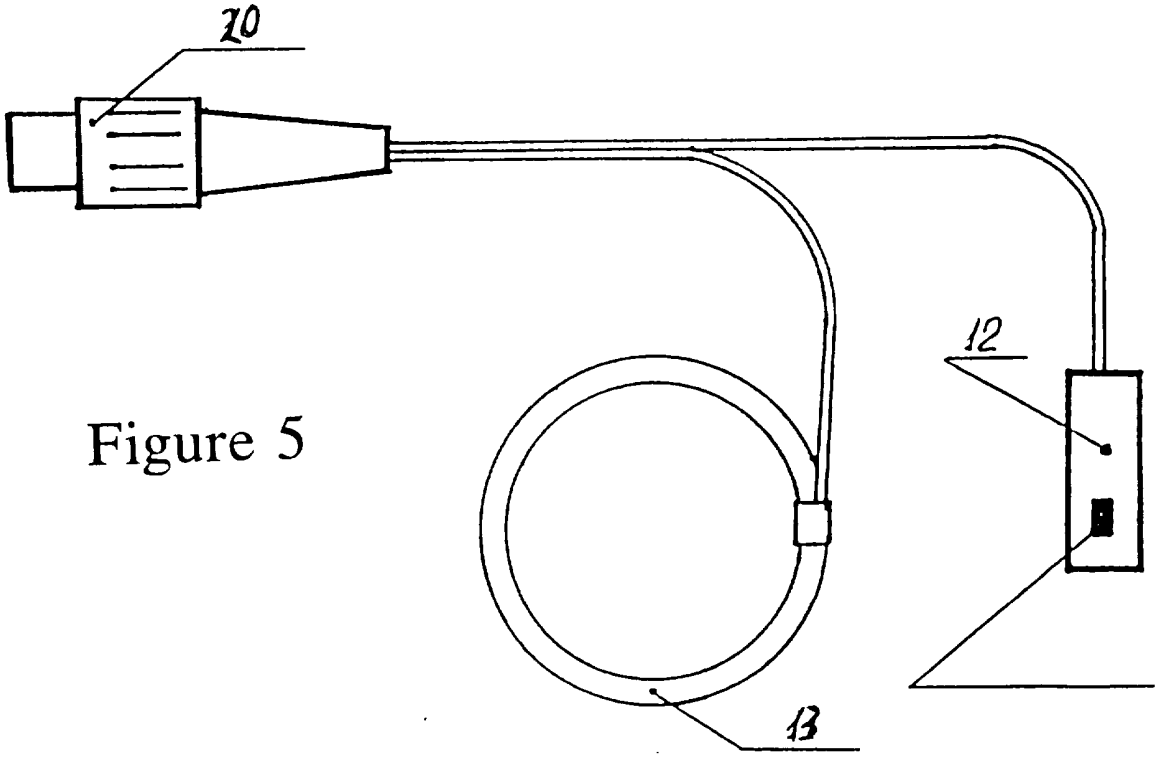

Figure 5

Figure 6

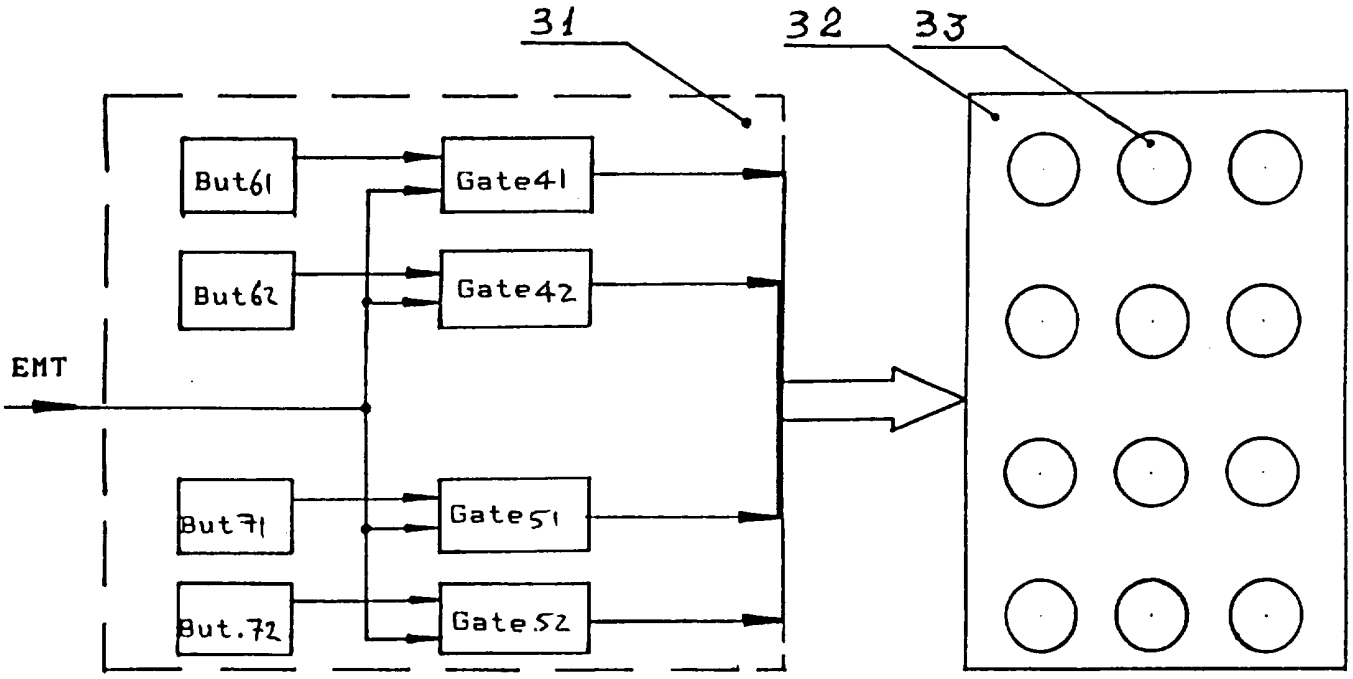

Figure 7

Electro-magnetic Therapy Device

This invention relates to an electro-magnetic device for the treatment of the human or animal body.

A number of electro-magnetic devices are known, for the treatment of a range of disorders or traumas of the human body. These are mainly of two types, one involving the use of a constant magnetic field provided by permanent magnets, the other involving the use of alternating or pulsed magnetic fields (typically operating in a frequency range of 10Hz to 1kHz and at an output of 1-15 watts).

We have now devised an electromagnetic device which is more effective than hitherto known devices in the treatment of a number of disorders or traumas of the human body.

In accordance with this invention, there is provided an electro-magnetic therapy device which comprises a coil for application to a subject to be treated, a control unit for supplying electrical pulses to the coil, and a sensor for application to the subject to sense a rhythmic function of the subject's body, and serving to synchronise the electrical pulses supplied to the coil.

Any of a number of biorhythms of the subject's body can be used for the synchronising purpose, e.g. brain rhythm, reorhythm etc.: however, most conveniently the cardio rhythm is used.

In particular, the sensor preferably comprises a sensor which responds to the pulsed flow of blood in the subject's blood vessels, and serves to synchronise therewith the electrical pulses supplied to the coil. Preferably the sensor comprises a photoelectric sensor which monitors variations in the light absorbed in the subject's tissues, in accordance with variations in the pressure in the blood vessels.

By supplying each electrical pulse at the instant of the peak of the blood flow pulse, we have found it possible to achieve positive results with an output 100 to 500 times lower than used in previous devices.

Preferably the output of the device is 8 to 20 mwatts/sq cm of the subject's skin. For curing trauma swells

with bruises, typically the rehabilitation period using our device is 3 to 4 days (as compared with the usual period of one week).

Preferably the electrical pulses are pulses of a high frequency signal, the frequency of which is preferably varied with the subject's pulse rate.

The device can be used effectively in the treatment of a wide range of disorders or traumas, including bone fractures, dislocations, sprains, haemorrhages, bruises and sports traumas. It can be used for reducing or removing swells including post-surgical swells, abscesses, lymph flow disruptions, etc., restoration of the functions of the liver, kidneys or intestines after toxic poisons, reduction or removal of bedsores, and the relief of pain due to arthritis, polyarthritis, osteoarthritis, arthroses, and osteohandroses for example. The device can be used for other conditions also.

Embodiments of this invention will now be described by way of examples only and with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic diagram showing a device in accordance with this invention, when applied to a subject;

FIGURE 2 is a schematic diagram, on an enlarged scale, of a sensor of the device when applied to the subject's finger;

FIGURE 3 is a circuit diagram of the device;

FIGURE 4 comprises front, rear, side and end views of the control unit of the device;

FIGURE 5 is a view of the coil and sensor and a connector for coupling these to the control unit;

FIGURES 6a and 6b show alternative forms of electrical pulses which can be supplied to the coil; and

FIGURE 7 is a schematic diagram of a modified device which comprises a mattress having a number of coils, and a switching unit for selecting which coils are operative.

Referring to Figure 1 of the drawings, a device in accordance with this invention comprises a control unit 10, a sensor 12 which in use is attached to a finger, for example of a person P to be treated, and an electromagnet coil 13 which is applied to the person or subject P at the site requiring treatment: the coil receives pulses of high frequency

alternating current from the control unit 10, these electrical pulses being synchronised with the pulses in the blood flow of the subject P, as detected by the sensor 12.

For the coil 13, we have used coils of 600 turns of enamelled wire, and of 15 to 100mm diameter. The appropriate diameter depends on the size of the trauma to be covered; if the trauma is large, then preferably the coil is moved periodically to different areas of the trauma. The coil is placed against the skin of the subject P so that its axis (and hence the magnetic field) is directed into the subject's body: if it is found necessary or desirable, the coil can be held in position against the subject's body using a piece of self-adhesive plaster or tape.

As shown in Figure 2, the sensor 12 may comprises a photo-electric sensor, comprising an infra-red emitting photodiode ED and photosensitive diodes RD. Infra-red light from the photodiode ED is transmitted through the skin and soft tissues of the subject's finger, reflected by the bone and transmitted back to the photosensitive diodes RD. The transmission path length, and hence the absorbtion of the light rays, varies with the periodic increases and decreases in blood pressure in the subject's blood vessels, and the light received by the photosensitive diodes RD varies correspondingly.

The sensor 12 can be applied to any convenient part of the subject's body, but preferably close to the trauma being treated, to avoid time differences between the peak in blood pressure at the two sites. However, the sensor 12 is preferably positioned away from muscles of the subject, as use of the muscles is liable to distort the output signals from the sensor. If the sensor 12 is applied to the finger, preferably it is secured in position using an elastic band applied around the finger and sensor, with light pressure. Otherwise, the sensor 12 may be secured to the subject using a piece of self-adhesive plaster to tape.

Referring to the circuit diagram of Figure 3, the pulse sensor 12 includes a pre-amplifier and its output signal is then passed to a variable-gain drive amplifier 2 in the control unit 10, the output of amplifier 2 being applied to a pulse detecting circuit 3. The output of pulse detecting circuit

3 is used by a feedback circuit 4 for automatic regulation of the variable-gain amplifier 2, and by a feedback circuit 5 for automatic regulation of the infra-red emitting photodiode ED of the sensor 12. Circuit 6 supplies a source voltage the level of which varies with the subject's pulse rate. A circuit 7 provides an alternating current output, the frequency of which varies with the voltage of the output from circuit 6 (with a steepness of 1hz/mv). Circuit 8 modulates the signal from circuit 7 according to the signal from amplifier 2, and applies this modulated signal to a power amplifier 9 which drives the coil.

It will be appreciated that the feedback circuit 4 regulates the variable-gain amplifier 2 with respect to variations in blood pressure, microcirculation and abrupt changes in pulse amplitude. Feedback circuit 5 regulates the photo-electric sensor with respect to variations in the thickness of the subject's epidermis or variations in external illumination.

As shown in Figure 4, the control unit 10 comprises a rectangular housing in which the electrical circuit of Figure 3 is enclosed. The circuit is powered by a 9 volt battery 18 located in a compartment at the rear of the housing, and normally closed by a cover 19. The battery 18 is rechargeable and a socket 15 is provided on the side of the housing, for connection of an electrical input to recharge the battery: a light 16 is provided to indicate that the battery is being recharged. The end of the housing is provided with a socket 17 for connection of cables to the sensor 12 and coil 13. The front of the housing is provided with a light 21 to indicate when the unit is switched on, a light 22 to indicate that the coil 13 is operative, a light 23 to indicate the occurrence of the subject's pulses, and a reset button 24. Figure 5 shows the sensor 12 and coil 13 and respective electrical leads to a plug 20 for coupling to the socket 17 of the control unit 10.

In use, the coil 13 is placed on the subject, at the site to be treated: if necessary the coil 13 is secured in position using a piece of self-adhesive plaster of tape. The subject places his finger on the sensor 12, and this is secured in position using an elastic band. The plug 20 is then

inserted into the socket 17, causing the light 21 to illuminate: after 2 to 4 seconds the pulse indicator 23 and the coil indicator 22 start blinking in synchronism. The user then presses the reset button 24 in order to start the device.

For treating bone fractures, the device is used preferably for 6 to 10 hours per day, in 3 or 4 sessions daily. In other cases, the device is used preferably for 4 to 6 hours, in 2 or 3 sessions daily.

For fresh trauma (not more than 2 or 3 weeks old), the electrical pulses applied to the coil 13 are preferably of single polarisation, as shown in Figure 6a. In cases of chronic inflammation, pulses of double polarisation as shown in Figure 6b are more effective: preferably a combination of single and double polarised pulses are used (typically with the double polarised pulse for 20 to 30% of the course of treatment). In the example shown in Figure 6a, the single polarisation pulse is a square pulse of a given polarity; in the example shown in Figure 6b, a square pulse of one polarity is immediately followed by a relatively short pulse of the opposite polarity.

Typically the output of the coil 13 is 8 to 20 mwatts/sq cm of the subject's skin.

Figure 7 shows a development of the device, in which a mattress is used, comprising an array of e.g. twelve coils 33, each typically of 70cm diameter, positioned between two relatively thick sheets of cloth 32. The output from the control unit 10, referred to above, can be applied to a switching unit 31 which comprises a series of gates 41-52, one for each coil 33, and a corresponding series of push-buttons 61-72 for enabling the respective gates. The user can select which of coils 33 are operative, by pressing the buttons associated with the appropriate ones of gates 41 to 52. The mattress can be used whilst the subject is asleep or whilst the subject is awake.

It will be appreciated that the devices which have been described are portable, low power devices which are simple to use and effective in treating a wide range of conditions.

Claims

1) An electro-magnetic therapy device which comprises a coil for application to a subject to be treated, a control unit for supplying electrical pulses to the coil, and a sensor for application to the subject to sense a rhythmic function of the subject's body, and serving to synchronise the electrical pulses supplied to the coil.

2) A device as claimed in claim 1, in which the sensor is arranged to respond to the subject's cardio rhythm.

3) A device as claimed in claim 2, in which the sensor is arranged to respond pulses in the blood flow through the subject's blood vessels.

4) A device as claimed in claim 3, in which the sensor comprises a photoelectric sensor arranged to monitor variations in the light absorbed by the subject's bodily tissues.

5) A device as claimed in any one of claims 2 to 4, arranged for the electrical pulses to be supplied to the coil substantivally at the peaks of the subject's blood flow pulses as detected by the sensor.

6) A device as claimed in any preceding claim, in which the control unit is arranged to supply the electrical pulses as pulses of a high frequency signal.

7) A device as claimed in claim 1, in which the control unit is arranged to vary the frequency of said signal in accordance with the subject's pulse rate as detected by the sensor.

8) A device as claimed in any preceding claim, in which the control unit is arranged to supply the electrical pulses as pulses of a single polarisation.

9) A device as claimed in any one of claims 1 to 7, in

which the control unit is arranged to supply the electrical pulses as pulses of a double polarisation.

10) A device as claimed in any preceding claim, comprising a plurality of coils for receiving the electrical pulses from the control unit, the coils being arranged in an array.

11) A device as claimed in claim 10, further comprising a switching unit for selecting to which coils of the array the electrical pulses are supplied.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
e Search report) 8

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Relevant Technical Fields

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(ii) Int Cl (Ed.6) A61N (2/00, 2/02)

Search Examiner
MR E QUIRK

Date of completion of Search
12 JULY 1995

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Documents considered relevant following a search in respect of Claims :-

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2270000 A	(GRACE)	
A	GB 2188238 A	(VMEI "LENIN")	
A	EP 0145173 A1	(ELECTRO-BIOLOGY)	

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