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(54) DEVICE FOR PREVENTING AND TREATING LOCOMOTION DISORDERS

(57) A device for mechanical stimulation of the foot support zones comprises four pneumatic chambers, two chambers being for each one of the feet, to create pressure to be exerted on the foot support zones, which chambers are equipped with valves and are coupled, via a receiver, to a pressure source, which source in turn is coupled to a control unit that controls the pressure-varying modes in the pneumatic chambers. The pneumatic chambers are intended to be disposed within footwear in the heel and tarsus area, and are coupled, through suitable pipelines, to a receiver; the pneumatic chambers being implemented such that when air is supplied, their volume is increased only in the direction perpendicular to the foot sole. The control unit comprises a microprocessor operated by a program that controls the air supply to the pneumatic chambers according to various modes of walking or run within the pneumatic chambers to the atmospheric pressure value; and said control unit is connected to a control input of the control valve, of the pressure sensor via the interface, and to a pressure source driver.

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Description

[0001] The invention relates to the art of medical instrument engineering, and can be suitably used in the medical fields that require prevention or treatment of disorders of locomotion (biomechanics of walking and run). Such disorders generally affect the patients who have not used their legs to support themselves for a long time. These can be a bed-ridden patient or spaceman staying in the zero-gravity state. Neurological patients may also be subjected to such condition.

[0002] Removal of the support loads on human feet during a prolonged bed rest (an ill person), or in the zero-g state (spaceman) is accompanied by a number of undesired alterations in morphology and in the leg movement control system. Such alterations relate to the foot sensory system, shin muscular system, osseous structure; and some alterations occur in the human posture regulation system.

[0003] "Deprivation of senses" emerging under said conditions becomes the cause of the absence of the initial link of the reflex arch that underlies the movement control. The absence of the uplink pulses from the foot mechanoreceptors brings about the conditions of undesired alterations in the locomotion system.

[0004] The claimed invention is directed to be used for prevention of such alterations.

[0005] Known is a "device for rehabilitation of the locomotor apparatus in the zero-gravity environment" (see, e.g. RU Patent 2148981 C1, July 14, 2000) whose action on human body is caused by excitation of the human sole receptor zones by the pneumatic-mechanical pressure created in the pulse mode.

[0006] This device has a number of drawbacks.

1. The device disclosed in said patent can be used only individually, for example - it can be used for spacemen, and its use in any clinical environment for a plurality of patients is rather difficult due to the following reasons.
For applying a local pressure on the anatomically characteristic foot zones, said device has two pneumatic boots provided with pneumatic modules. Said "pneumatic boots" have a particular size, and the "pneumatic modules" are positioned therein in strictly determined places that correspond to zones of aggregation of Vater-Pacini corpuscles on the foot sole of a patient to whose size this pneumatic boot is made. The device must be manufactured in view of individual anatomic features of each patient's foot (first of all, sizes of foot length and width, and also possible deformities characteristic of some illnesses are taken into account).

2. The foot-squeezing sleeves in said known device cause excitation of mechanoreceptors on the foot dorsal side, which mechanoreceptors have no relation to organization of the support reaction and to formation of the reflex arch that underlies the locomotion control.
The matter is that the squeezing sleeves, that serve to "draw" tightly the pneumatic modules to the sole, operate in beat of delivery of pressure into the pneumatic modules that act on the sole mechanoreceptors, i.e. the device exerts the pulsed mechanical action on the foot both from below and above. Thus the foot is squeezed entirely, and as the sleeves provide the contact surface area greater than that provided by pneumatic modules, then the pressure exerted from above is perceived as being stronger than the pressure acting on the sole. Such squeezing result in the non-physiological, undesired mechanical pressure on the limb, which pressure causes a patient's negative emotional reaction.

3. Said device has the unjustifiably complicated design, for it comprises three pneumatic modules.
Said prior-art device has three pneumatic modules for each of the pneumatic boots: 1 being in the calcaneal area, and 2 pneumatic modules (the lateral and medial modules) being for the boot tip portion. Each pneumatic module has its own operation-maintenance system (a separate air-delivery line, a valve, representation in a microprocessor). But the anatomical arrangement of vater-Pacini corpuscles is known to appear in the foot metatarsus zone as two spots (the medial and lateral spots), and there is no functional difference between these aggregations of receptors. Such arrangement of Vater-Pacini corpuscles is caused by the foot anatomy: in these locations the pressure exerted from a support is stronger due to the presence of tubers of the foot sole.
When contacts are established with a support, these aggregations are irritated (excited) practically simultaneously. For this reason the load-applying members in the boot front portion can be united into single member, which approach will simplify the design significantly and improve its reliability.

4. In said known device, minimal pressure persists, which pressure is "adverse or useless for adaptation of receptors".
"The persistent" level of pressure in said pneumatic modules (while there is their connection to the minimal pressure receiver) causes deterioration of accuracy of simulation of the pressure factor, and in these terms such minimal pressure can be considered as adverse (conditions for adaptation of receptors), or as useless at least.

5. The presence of two receivers in said known device complicates its design.
The device has two receivers and provides two pressure levels - minimal and maximal levels. The purpose of the device consists in simulation of the phys-

ical factors acting on the human foot sole, which factors are characteristic of locomotion in environment of normal gravity. But the pressure acting on the zones of location of Vater-Pacini corpuscles in time of walking or running emerges only in the phase of contact with a support, and any other time this pressure is zero. Said pressure in the device must be released so that to be reduced to the atmospheric pressure. For this reason the presence of the minimal-pressure receiver is not justified in terms of physiology.

6. Disposition of the pneumatic modules in the insole body of the known device, which circumstance restricts the chamber (membrane) travel, for which reason the sense of pressure is weakened.

[0007] The claimed device is contemplated to eliminate said drawbacks through use of a different design of said pneumatic boot.

[0008] **The technical objective** of the invention consists in provision of a device for prevention and treatment of locomotion disorders, which device will be a more efficient, have an higher manufacturability and be more readily used. A greater efficiency is achieved through a physiologically improved action to be exerted on the receptors, which in turn provides better simulation of the walking or running modes. Said physiologically improved action to be applied by the claimed device is obtained by a more correct pressure to be exerted on a foot owing to elimination of any pressure on the foot dorsal side, and also by elimination of said minimal pressure in the device system. Manufacture and use of the claimed device is rendered more simple and more ready for being used by elimination of the necessity to make any special footwear, and by the possibility to use the user's individual footwear, by exclusion of any second receiver and by exclusion of one pneumatic chamber.

[0009] Said objective of the claimed invention is to be attained, according to its 1st Version as follows:

In the prior-art device for prevention and treatment of locomotion disorders, comprising: two boots, each of which boots comprises a means for creating pressure to be exerted on the reflexogenic foot zones, which means is implemented as pneumatic modules consisting of a pneumatic chamber and a pressure source being a compressor with an electric motor, both being connected - through a receiver provided with a pressure sensor and control valves - to each one of the pneumatic chambers;
the inputs for controlling the electric motor by the compressor, the controlling inputs of the receiver's control valves, and the pressure sensor output are connected, via an interfacing unit, to the compressor; each boot is a user's individual footwear; number of the pneumatic modules for each boot is 2; the compressor and receiver are shared by all pneumatic modules; the receiver through a separate air hose is connected to each one of the pneumatic chambers, said chambers further comprising an electropneumatic valve adapted to supply air therethrough out of the receiver into a pneumatic chamber and to release an excess air out of a pneumatic chamber into atmosphere, as well as to provide the pressure in a pneumatic chamber being equal to the atmospheric pressure; the controlling input of each electropneumatic valve and of each one of the pressure sensors being connected, via an interfacing unit, to a microprocessor operated by a program that causes the air to be supplied, simulates various modes of either walking or run; said means for creating pressure to be exerted on the reflexogenic zones further comprises an insole whose sizes correspond to sizes of user's individual footwear; the insole comprises a means for removably securing the pneumatic chambers thereto, which pneumatic chambers are removably positioned on suitable areas of the insole. The pneumatic chambers being implemented such that when pressure is delivered, they increase their volume only along the vector perpendicular to the plane of the foot sole; shape and sizes of a pneumatic chamber of one of the pneumatic modules correspond to those of the foot metatarsus portion that comprises the medial and lateral areas of Vater-Pacini corpuscles; and shape and size of the second pneumatic module's pneumatic chamber correspond to those of the foot calcaneal portion that also comprises Vater-Pacini corpuscles. The device can be further provided with a display to represent the device performance data.

The objective according to the 2nd Version In the prior-art device for prevention and treatment of locomotion disorders, comprising: two boots, each of which boots comprises a means for creating pressure to be exerted on the reflexogenic foot zones, which means is implemented as pneumatic modules consisting of a pneumatic chamber and a pressure source being a compressor with an electric motor, both being connected - through a receiver provided with a pressure sensor and control valves - to each one of the pneumatic chambers;
the inputs for controlling the electric motor by the compressor, the controlling inputs of the receiver's control valves, and the pressure sensor output are connected, via an interfacing unit, to the compressor; each boot is a user's individual footwear; number of the pneumatic modules for each boot is 2; the compressor and receiver are shared by all pneumatic modules; the receiver through a separate air hose is connected to each one of the pneumatic chambers, said chambers further comprising an electropneumatic valve adapted to supply air therethrough out of the receiver into a pneumatic chamber and to release an excess air out of a pneumatic chamber into atmosphere, as well as to provide the pressure

in a pneumatic chamber being equal to the atmospheric pressure; the controlling input of each electropneumatic valve and of each one of the pressure sensors being connected, via an interfacing unit, to a microprocessor operated by a program that causes the air to be supplied, simulates various modes of either walking or run; said means for creating pressure to be exerted on the reflexogenic zones further comprises an insole whose sizes correspond to sizes of user's individual footwear; the insole comprises a means for removably securing the pneumatic chambers thereto, which pneumatic chambers are removably positioned on suitable areas of the insole. The pneumatic chambers being implemented such that when pressure is delivered, they increase their volume only along the vector perpendicular to the plane of the foot sole; shape and sizes of a pneumatic chamber of one of the pneumatic modules correspond to those of the foot metatarsus portion that comprises the medial and lateral areas of Vater-Pacini corpuscles; and shape and size of the second pneumatic module's pneumatic chamber correspond to those of the foot calcaneal portion that also comprises Vater-Pacini corpuscles; the pneumatic chambers being implemented in the form of corrugated bellows provided, from below and above, with solid plates; on the upper plate, for the purpose of immediate contact with skin of a user, rigid members are removably positioned; the ratio of surface area of the rigid member and surface area of the front (metatarsal) pneumatic chamber is 1:9, and the ratio of the rigid member's surface area and surface area of the rear (calcaneal) pneumatic chamber is 1:10.

[0010] The device can be further provided with a display to represent the device performance data.

[0011] The claimed device is explained in Figs. 1, 2, 3, 4 having the following reference numerals: /1/ - boot, /2/ - electronic-pneumatic unit, /3/ - pneumatic chambers, /4/ - compressor having an electric motor, /5/ - air-supply line, /6/ - receiver, /7/ - receiver's pressure sensor, /8/ - connection hoses, /9/ - an electropneumatic valve of a pneumatic chamber, /10/ - insole, /11/- circuit for controlling an electropneumatic valve, /12/ - pneumatic chambers in the form of corrugated bellows, /13/ - solid plates, /14/ - rigid members, /15/ - microprocessor, /16/ - control valves, /17/ - display.

[0012] **Pneumatic chambers** are the sealed chambers made of a rubber cloth, their volume is small, they have a pneumatic connection for connection with conduits extending from the receiver via the pneumatic valves. The lower portion of the pneumatic chambers has an adhesive-pile band glued thereon, using which band said chambers are secured to elastic flexible insole, with the secured complementary portion of said band.

[0013] The pneumatic chambers on soft insoles are to be inserted into an individual footwear. These insoles are not limited by any structural members, they provide a broader contact with skin as compared with the prototype version; and the pressure distribution from the chamber centre to periphery thereof provides a better simulation of the real pattern.

[0014] For each patient's leg intended are two pneumatic chambers: the calcaneal and metatarsal (frontal and rear) chambers. The front chamber is elongated, and its surface area spreads to the medial and lateral zones of Vater-Pacini corpuscle arrangement zones.

[0015] The reduced number of chambers results in the following effects, as regards one leg:

a) only two pneumatic inputs (tubes) are required for one boot;
b) 2 valves;
c) a program controls only two pulsed pressure deliveries of a predetermined duration, and regulates only two time intervals between pulses in the rear and front chambers, and the interval between pulses in the right boot and left boot.

[0016] **Insoles** are inserted into patient's individual footwear. Thus provided is the possibility to dispose pneumatic chambers in view of patient's foot sizes and peculiarities; and the pneumatic chambers are positioned in a required location.

[0017] As the **individual footwear** is contemplated to be used for the treatment seance, then any system of tight adjustment (of the squeezing sleeves) is not necessary. This approach provides advantages in respect of rational use of maximum capacity of the compressor, because the serviced volume is reduced two times.

[0018] The **compressor** of this system must meet rather high requirements. To simulate the action to be exerted in the run pace, the system must create pressure in the pneumatic chamber and release said pressure to zero value in very brief time. Rate of cycles may be frequent, requiring large consumption of air. Any additional volume is adverse under these conditions.

[0019] Further, in case of absence of said squeezing sleeves, simulation of the pressure to be exerted on foot during locomotion represents the natural conditions better.

[0020] The device has only one receiver configured to maintain a maximal predetermined pressure. Pressure in the pneumatic chambers is released to 0 value.

[0021] The compressor operates in the stationary mode. The microprocessor is not coupled to the compressor.

[0022] The pneumatic chambers are connected to the electronic-pneumatic unit (viz. the receiver) through separate tubes. The valves further are electrically connected to the unit, and during the treatment seance, the valves are positioned on the patient's leg in the vicinity of the pneumatic chambers in the sleeve attached to the patient's ankle.

[0023] The electronic-pneumatic unit causes the device to operate, and controls and monitors the action to

be exerted on the foot support zones.

[0024] The control unit of the device includes the integrally implemented keyboard of 16 film-type keys, and a liquid-crystal display.

[0025] The control system provides operation of the device in the automatic mode according to a strict cyclogram.

[0026] The automatic operation mode according to a flexible program allows select different versions of operation of the valves and their interrelated turning-on according to the walking or run cyclogram.

[0027] The manual mode provides the separate or simultaneous activation of the valves.

[0028] Pressure in the pneumatic chambers is predetermined as selected by an operator within the range of 0 - 0.5 kgf/cm, increments being 0.001 kg/cm.

[0029] Liquid-crystal display 20 has two lines that accommodate twenty alphanumeric symbols on each line. The display is adapted to provide imaging of the following information: tuning-on of each one of the valves, a predetermined and current pressure in the receiver, an exerted action mode ("walking-1", "walking-2", " standing"), a predetermined time period of a cycle, an exerted action, remaining cycle time period.

[0030] The following values are reproduced in the modes according to a strict cyclogram: pace of walking (run), duration of single stride, duration of dual stride, duration of the support phase of each leg, duration of the dual-support phase (for walking), duration of the transfer phase, duration of the leap phase (for run); speed of motion being simulated within the following values: for "walking-1" the rate is 75 strides/min, for "walking-2" the rate is 120 strides/min, the run motion rate is 150 strides/min.

[0031] The operation time period of the claimed system is preset within the range of 1 - 60 min, increments being 1 min long, the cycle time count beginning from the moment a predetermined pressure has been generated in the receiver. Information on turning-on of the valves is duplicated by the light signals emitted by LEDs.

[0032] The pneumatic chambers can be embodied in 2 versions of their design (the versions may be used depending on goals and capabilities of a user).

[0033] **1st Version** - the pneumatic chambers are implemented as sealed chambers made of a rubber cloth, tailored and disposed in a boot such that as pressure grows, their volume increases only in the direction of the vector that is perpendicular to the foot sole plane.

[0034] **2nd Version** represents the pneumatic chambers in the form of corrugated bellows made of rubber having solid plates attached on its top and bottom. The upper moveable plate has the contact elements that send the pressure pulses onto the body in the zones of location of Vater-Pacini corpuscles. Said pneumatic chambers operate as an amplifier owing to the difference between surface areas of a pneumatic chamber and a contact element. Two pneumatic chambers are positioned on each foot.

[0035] Surface area of the front metatarsus chamber is 70 - 80 cm^2, that of a contact element: 8 - 9 cm^2. Ratio of surface areas and, accordingly, the design ratio of the pressure within a chamber and the pressure acting on the body is 1:9.

[0036] In the calcaneal zone disposed is the chamber whose surface area is 40 - 50 cm^2, surface area of its contact being 4 - 5 cm^2, so that ratio of 1:10 is achieved.

[0037] Said different ratios of the pressures created in a pneumatic chamber and acting on the body in the calcaneal and metatarsal zones improves the simulated pressure to be exerted on the sole as a patient really walks and runs, when the pressure acting on the heel exceeds that on toes. This approach allows different pressures in the foot local zones - with equal pressures within the pneumatic chambers (this design provides exactly this feature, for the device has only one receiver).

[0038] The contact elements are secured to said plate by means of an adhesive-pile band. The device is complete with a kit of contact elements having various surface area and thickness. Using different thickness of the contact elements, the depth of impression done into the foot soft tissues can be regulated.

[0039] The device operates as follows.

[0040] Provided are insoles /10/ (the right and left ones) sized to match a patient's individual footwear (boot) /1/. Pneumatic chambers /3/ are secured, using adhesive-pile band, on the pneumatic chambers /10/ on the locations corresponding to disposition of Vater-Pacini corpuscles in the calcaneal and metatarsal zones; and the connecting hoses /8/ extending from the chambers /3/ are brought out of the footwear. The boots /1/ are fastened, tied. The sleeves comprising 2 pneumatic valves /9/ for each leg are positioned on the patient's ankles. The connecting hoses of the pneumatic chambers /8/ are connected to valves /9/. The control circuits from the valves /11/ are coupled separately for the right and left legs through electrical connectors to the microprocessor /15/. The microprocessor /15/ is connected to power supply.

[0041] A program for exerting action in a given séance is selected by means of the keyboard on the display /17/: a value of the pressure to be created in the chambers; a cycle mode - "walking-1" (75 strides/min), "walking-2" (120 strides/min), run (150 strides/min); a cycle time period. "Start" button is pressed, the program is launched, the compressor (4) starts to operate. A pressure predetermined on the display (i.e. on the control unit) is created in the receiver (6). The control valves (16) open when the pressure sensor (7) sends a signal whose value exceeds a predetermined pressure value. The receiver's pressure sensor communicates with the control valves via the microprocessor (15).

[0042] The pressure developed in the receiver is delivered, via the outlet tubes (5), into the pneumatic chambers (3) at the moments when the electric valves (11) disposed in the sleeve on the patient's leg are open at their inlet. Pressure out of the chamber is released when a valve is open at its outlet. Electrical communication of

the electric valves with control unit (the microprocessor) controller ensures execution of a given program of a seance: rate of activations of each one of 4 pneumatic valves (opening/closure of inlet and outlet), provision of the required time intervals, pauses between activations of 2 valves on each leg, between activations of the valves on the right and left legs - characteristic of the predetermined modes (walking-1, walking-2, run).

[0043] In the course of a seance, operators perform monitoring of the following information imaged on the display: mode name, activation of each one of the valves (duplicated by the lit LDDs); the predetermined and current values of pressure in the receiver, a predetermined duration of cycle, a remaining time of cycle.

[0044] After expiration of a predetermined time (1 hour at most), power supply is disconnected automatically.

[0045] The device elements are removed off a patient, and the zones wherein said action has been exerted are examined.

Claims

1. A device for prevention and treatment of locomotion disorders, comprising two boots, each of which boots comprises a means for creating pressure to be exerted on the reflexogenic foot zones, which means is implemented as pneumatic modules consisting of a pneumatic chamber and a pressure source being a compressor with an electric motor, both being connected - through a receiver provided with a pressure sensor and control valves - to each one of the pneumatic chambers;
the input for controlling the electric motor by the compressor, the controlling inputs of the receiver's control valves, and the pressure sensor output are connected, via an interfacing unit, to the compressor;
characterized in that each boot is a user's individual footwear; number of the pneumatic modules for each boot is 2;
the compressor and receiver are shared by all pneumatic modules;
the receiver through a separate air hose is connected to each one of the pneumatic chambers, said chambers further comprising an electropneumatic valve adapted to supply air therethrough out of the receiver into a pneumatic chamber and to release an excess air out of a pneumatic chamber into atmosphere, as well as to provide the pressure in a pneumatic chamber being equal to the atmospheric pressure;
the controlling input of each electropneumatic valve and of each one of the pressure sensors being connected, via an interfacing unit, to a microprocessor operated by a program that causes the air to be supplied, simulates various modes of either walking or run;
each boot further comprising an insole whose sizes correspond to sizes of user's individual footwear; the insole preferably comprises a means for removably securing the pneumatic chambers thereto, which pneumatic chambers are removably positioned on suitable areas of the insole;
the pneumatic chambers being implemented such that when pressure is delivered, they increase their volume only along the vector perpendicular to the plane of the foot sole;
shape and sizes of a pneumatic chamber of one of the pneumatic modules correspond to those of the foot metatarsus portion that comprises the medial and lateral areas of Vater-Pacini corpuscles; and shape and size of the second pneumatic module's pneumatic chamber correspond to those of the foot calcaneal portion that also comprises Vater-Pacini corpuscles.

2. The device as claimed in Claim 1, **characterized in that** the device further comprises a display to represent the device performance data.

3. A device for prevention and treatment of locomotion disorders, comprising two boots, each of which boots comprises a means for creating pressure to be exerted on the reflexogenic foot zones, which means is implemented as pneumatic modules consisting of a pneumatic chamber and a pressure source being a compressor with an electric motor both connected - through a receiver provided with a pressure sensor and control valves - to each one of the pneumatic chambers;
the input for controlling the electric motor by the compressor, the controlling inputs of the receiver's control valves, and the pressure sensor output are connected, via an interface, to the compressor;
characterized in that each boot is a user's individual footwear; number of pneumatic modules for each boot is 2;
the compressor and receiver are shared by all pneumatic modules;
the receiver through a separate air hose is connected to each one of the pneumatic chambers, said chambers further comprising an electropneumatic valve adapted to supply air therethrough out of the receiver into a pneumatic chamber and to release an excess air out of a pneumatic chamber into atmosphere, as well as to provide the pressure in a pneumatic chamber being equal to the atmospheric pressure;
the controlling input of each electropneumatic valve and of each one of the pressure sensors being connected, via an interfacing unit, to a microprocessor operated by a program that causes the air to be supplied, simulates various modes of either walking or run;
each boot further comprising an insole whose sizes correspond to sizes of user's individual footwear; the insole preferably comprises a means for removably securing the pneumatic chambers thereto, which

pneumatic chambers are removably positioned on suitable areas of the insole;
the pneumatic chambers being implemented such that when pressure is delivered, they increase their volume only along the vector perpendicular to the plane of the foot sole;
shape and sizes of a pneumatic chamber of one of the pneumatic modules correspond to those of the foot metatarsus portion that comprises the medial and lateral areas of Vater-Pacini corpuscles; and shape and size of the second pneumatic module's pneumatic chamber correspond to those of the foot calcaneal portion that also comprises Vater-Pacini corpuscles; the pneumatic chambers being implemented in the form of corrugated bellows provided, from below and above, with solid plates; on the upper plate, for the purpose of immediate contact with skin of a user, rigid members are removably positioned; the ratio of surface area of the rigid member and surface area of the front (metatarsal) pneumatic chamber is 1:9, and the ratio of the rigid member's surface area and surface area of the rear (calcaneal) pneumatic chamber is 1:10.

4. The device as claimed in Claim 3, **characterized in that** the device further comprises a display to represent the device performance data.

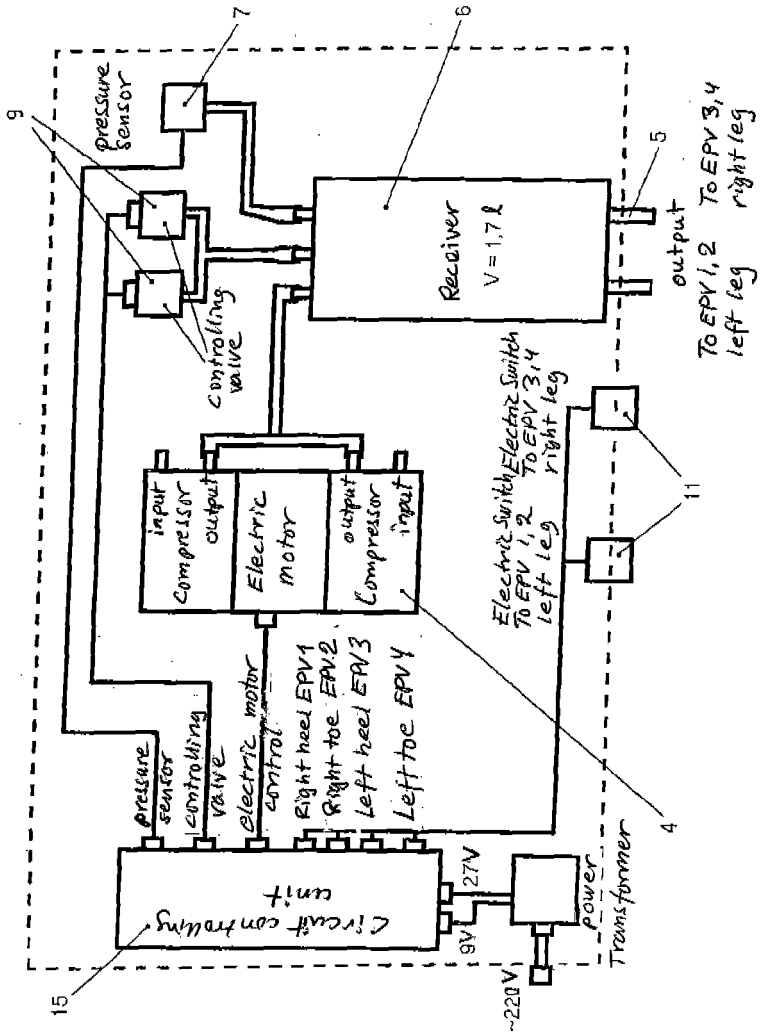

7
6
9
pressure sensor
5
Receiver
V = 1,7 l
output
To EPV 1, 2
left leg
To EPV 3,4
right leg
controlling valve
Electric Switch
To EPV 3,4
right leg
Electric Switch
To EPV 1, 2
left leg
11
input
Compressor
output
Electric motor
output
Compressor
input
Right heel EPV 1
Right toe EPV 2
Left heel EPV 3
Left toe EPV 4
electric motor control
pressure sensor
controlling valve
4
Circuit controlling unit
9V
27V
Power Transformer
15
~220V

Figure 1

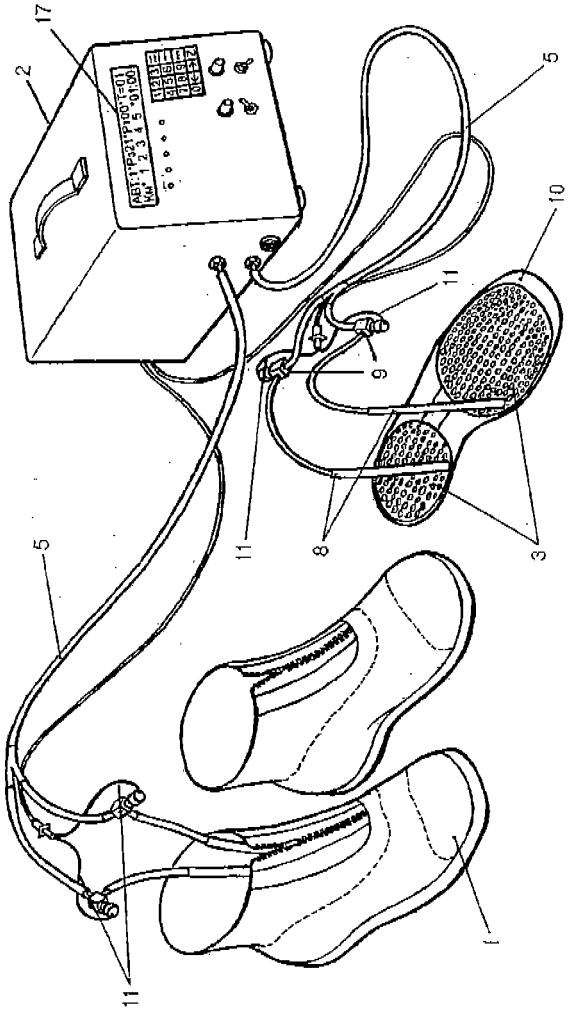
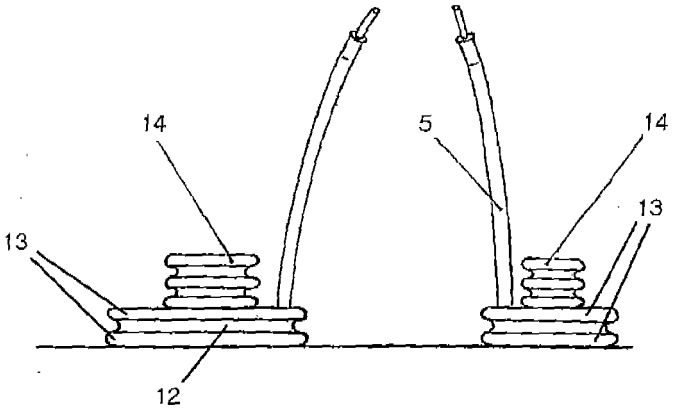


Figure 2



Фиг. 3.

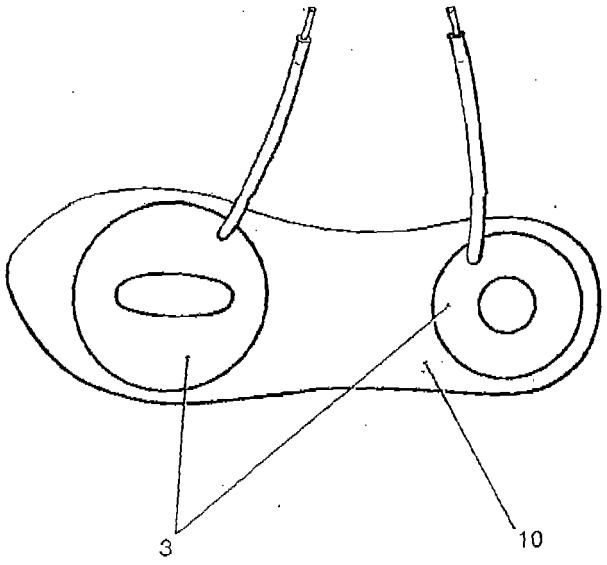


Figure 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU2005/000188

A. CLASSIFICATION OF SUBJECT MATTER

A61H 1/00 *(2006.01)*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61H 1/00, 9/00, 39/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	RU 2148981 C1 (GRISHKIN NIKOLAI VASILIEVICH et al) 20.05.2000	1-4
A	SU 1258408 A1 (RIZHSKY MEDITSINSKY INSTITUT) 23.09.1986	1-4
A	SU 1090390 A (TSENTRALNY NAUCHNO-ISSLEDOVATELSKY INSTITUT TRAVMATOLOGII I ORTOPEDII IM. N. N. PRIOROVA) 07.05.1984	1-4
A	RU 2020913 C1 (SHKRABOV BORIS SEMENOVICH) 15.10.1994	1-4
A	RU 5458562 A (THE UNITED STATES OF AMERICA AS REPRESENTED BY THE SECRETARY OF THE NAVY) 17.10.1995	1-4
A	US 5000164 A (THE UNITED STATES OF AMERICA AS REPRESENTED BY THE SECRETARY OF THE NAVY) 19.03.1991	1-4

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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Date of the actual completion of the international search	Date of mailing of the international search report
02 December 2005 (02.12.2005)	22 December 2005 (22.12.2005)
Name and mailing address of the ISA/	Authorized officer
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Patent documents cited in the description

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