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(54) METHOD FOR ACCELERATING THE RECOVERY OF DEEP DIVERS AND A DEVICE FOR CARRYING OUT SAID METHOD

(57) The invention relates to medicine and physiotherapy, in particular, to the method for recovery of deep divers. The method involves arranging a pneumomassage device in a decompression chamber and placing a diver on the pneumatic cuff of said pneumomassage device. The device for accelerating the recovery of deep divers comprises a decompression chamber provided with a pneumomassage device. The pneumomassage process makes it possible to redistribute the blood circulation of the organism, in particular to substantially increase the cutaneous blood circulation, thereby making it possible to enhance nitrogen release through the cutaneous pores and to reduce pressure on the pulmonary system. The inventive method makes it possible to reduce the time of recovering people working in extreme conditions.

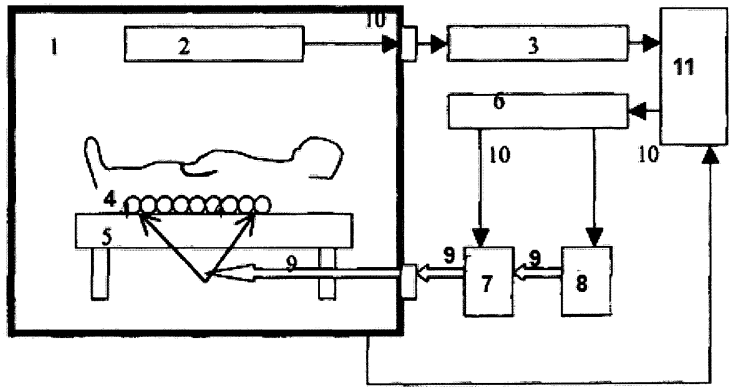

Fig. 2

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Description

[0001] The invention relates to medicine and may be used for accelerated recovery of deep divers after performing underwater work, in particular, for carrying out active degassing of the body.

[0002] After performing underwater work at high pressure blood and other body fluids and tissues are saturated with inert gases, substantially nitrogen. Due to inadequate decompression when transiting from high-pressure environment to lower-pressure environment in blood and body tissues there occur free gas bubbles disturbing blood micro- and macrocirculation in consequence of which decompression sickness or caisson disease develops. The risk of this disease increases at long-lasting stay under high pressure which most commonly takes place when working at great depths. Under such conditions there occurs full saturation of all body tissues and fluids with gases. Thus, at long-lasting work of a diver his blood and tissues contain a large amount of gas, first of all nitrogen. On returning to normal atmospheric pressure nitrogen dissolved in blood expands forming gas bubbles which cause pain and disturb blood circulation in small blood vessels including brain blood vessels. Pain, paralyses and some other evidences can be eliminated, however, with diver reentering the environment of increased atmospheric pressure with gradual decreasing this pressure which results in resorption of the formed gas bubbles.

[0003] According to Patent SU 1 839 983 it is known "Method of treatment of decompression sickness" in which extracorporal vein-venous hemoperfusion is performed through desaturation container with blood substitute at normal atmospheric pressure of gaseous environment. The disadvantage of the method disclosed in Patent SU 1,839,983 is the complexity of carrying it out and the usage of complex equipment.

[0004] As the closest analog regarding the claimed method, there taken the known from Patent RU 2 251 512 "Method of decompression" which consists in that after bringing a diver up to the surface he is placed into a special caisson (decompression) chamber where within several hours the pressure is gradually decreased, from the pressure at which the diver worked underwater to ambient atmospheric pressure. In the process along with the step-by-step decompression, recompression (the repetitive increase of pressure) is used [1]. Therewith, nitrogen dissolved in blood is eliminated. The disadvantage of the method disclosed in Patent RU 2 251 512 is a long time of staying in the chamber since it is necessary to remove all nitrogen not only from the blood channels, but also from body tissues.

[0005] An object of the invention is to provide method and device which will promote accelerating the process of diver recovery, improving the reliability of inert gas removal from the body, and preventing the development of caisson disease after leaving the pressure chamber.

[0006] According to the present invention the object is achieved by the method for accelerating the recovery of deep divers which is carried out as follows: after bringing a diver up to the surface he is placed in a decompression chamber provided with a pneumomassage device comprising a multisection pneumatic cuff with elastic pressurized sections separated from each other. The diver is lied down on the pneumatic cuff arranged on a couch, in which in accordance with certain program the pressure of compressed air is changed in consequence of which the elastic pressurized sections of the pneumatic cuff press on the respective areas of the diver's body and massage them thereby accelerating the circulation of body fluids and the removal of gas from the body tissues. Changing (decreasing) pressure in the decompression chamber can be performed constantly or stepwise, therewith the step-by-step decrease of pressure followed by massage which is performed at constant pressure during intervals between the changes of pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

Fig. 1 is a comparative sketch of blood flow redistribution in human body in the state of rest and muscular load.

Fig. 2 is a scheme of accelerated recovery of deep divers.

REFERENCE NUMERALS

[0008]

1 - a decompression chamber;
2 - body state observation sensors;
3 - measuring-recording instrumentation;
4 - a pneumatic cuff with elastic pressurized sections;
5 - a functional couch (chair);
6 - a pneumomassage device control block;
7 - an electro-driven pneumatic valve;
8 - a compressor;
9 - pneumo-communications;
10 - electro-communications;
11 - a synchronization unit for the pneumomassage device and a pressure control system in pressure chamber.

[0009] Performing pneumomassage is similar to passive exercises, i.e. the diver is motionless. During pneumomassage the blood flow redistribution in body takes place, the cutaneous blood circulation is improved, that, in turn, essentially enhances gas release through the cutaneous pores. As Fig. 1 shows, the cutaneous blood circulation at rest accounts for 3-6 per cent, the muscles blood circulation accounts for 15-20 per cent (at the left of Fig. 1). On exertion the cutaneous and muscles blood circulation increase to 80-85 per cent in total (at the right

of Fig. 1), and cerebral blood circulation decreases from 13-15 to 3-4 per cent, and this gives the possibility to withdraw a substantial part of gas release load from the lungs.

[0010] The method of the present invention has substantial advantages: it makes possible to activate the release of nitrogen dissolved in blood and tissues and to reduce the period of the diver's rehabilitation.

[0011] The method is carried out by means of the device comprising: a decompression chamber 1 equipped with diver's state observation sensors 2; a couch (or chair) 5 and arranged on it a multisection pneumatic cuff 4 with elastic pressurized sections into which via pneumo-communications 9 compressed air is supplied in accordance with certain program. The air is supplied via pneumo-communications 9 by means of a compressor 8 and an electro-driven pneumatic valve 7 the work of which is controlled by a control block 6 via electro-communications 10. In the process measuring-recording instrumentation 3 monitors the diver's state. The device includes a synchronization unit 11 for the pneumomassage device and a pressure control system in pressure chamber.

[0012] The method is carried out as follows: after bringing the diver up to the surface he is placed in the decompression chamber 1, lied down on the multisection pneumatic cuff 4 arranged on the couch 5. Then the diver's functional state is determined and the pneumomassage device control block 6 is programmed. The diver's body state is monitored by means of the sensors 2 and, if necessary, the pneumomassage program in the control block 6 is corrected by means of the measuring-recording instrumentation 3. The synchronization unit 11 makes it possible to supply air into the pneumatic cuff 4 only after achieving the necessary pressure in the chamber 1.

[0013] The realization of the present method makes it possible to increase the efficiency of inert gases removal from diver's body fluids and tissues, thereby preventing even the possibility of caisson disease development after completing the decompression. In addition, under reduced pressure conditions the body detoxication takes place due to removal of toxic volatile metabolic products.

Sources of information:

[0014]

1. f December 26, 2003
2. Кровообращение (translated from English)
M, «Медицина», 1976. СТр. 463.
3. Patent SU 1 839 983.
4. Utility Model Patent of Ukraine No. 26028

Claims

1. A method for accelerating the recovery of deep divers comprising placing a diver in a decompression chamber, wherein during the diver stay in the decompression chamber he is given the programmed massage by means of a multisection pneumatic cuff, meanwhile the pressure in the decompression chamber is gradually reduced.

2. The method according to claim 1, wherein the pressure in the decompression chamber is reduced stepwise, and massage is performed at constant pressure during intervals between the changes of pressure.

3. A device for accelerating the recovery of deep divers comprising a decompression chamber, wherein the decompression chamber is equipped with a pneumomassage device.

4. The device according to claim 3, wherein the device further comprises the multisection pneumatic cuff with elastic pressurized sections separated from each other, a programmed control block, an electro-driven pneumatic valve and a compressor.

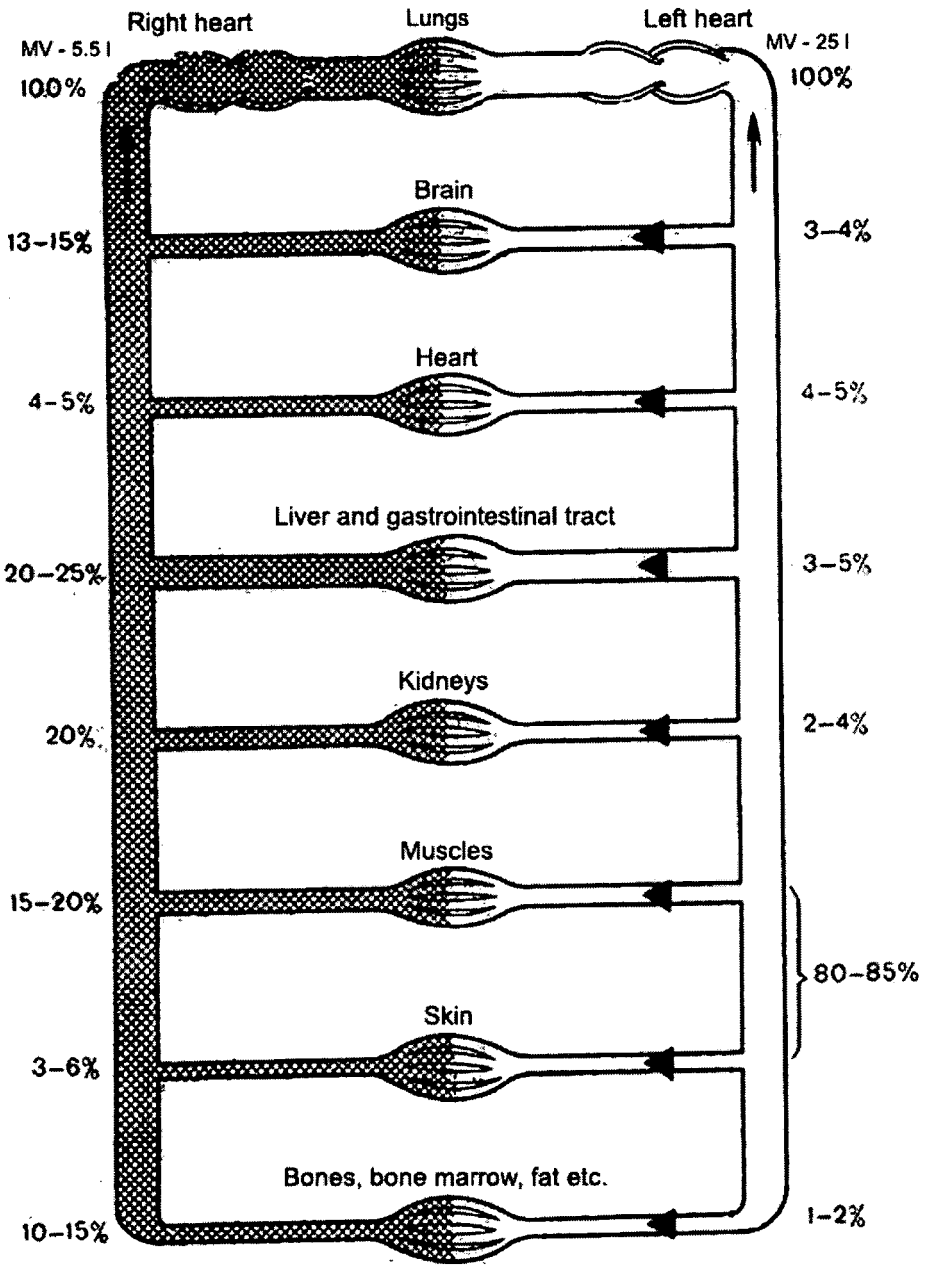
Right heart
Lungs
Left heart
MV - 5.5 l
100%
MV - 25 l
100%
Brain
13–15%
3–4%
Heart
4–5%
4–5%
Liver and gastrointestinal tract
20–25%
3–5%
Kidneys
20%
2–4%
Muscles
15–20%
80–85%
Skin
3–6%
Bones, bone marrow, fat etc.
10–15%
1–2%

Fig. 1

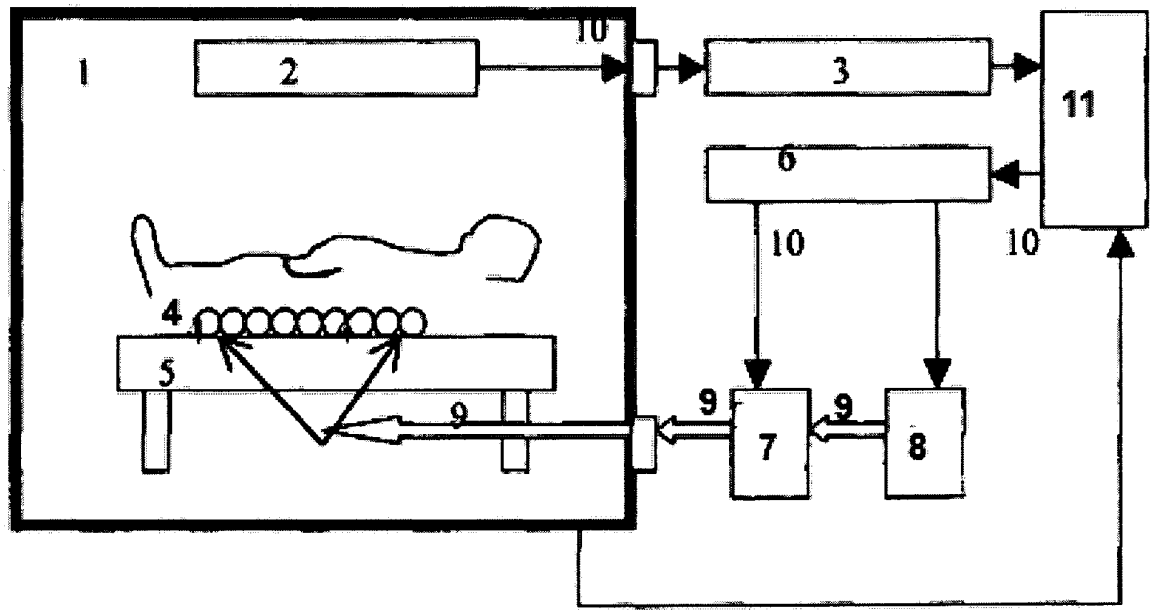

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/UA 2008/000066

A. CLASSIFICATION OF SUBJECT MATTER

B63C 11/32 *(2006.01)*
A61H 9/00 *(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)

B63C 11/00, 11/02, 11/32, A61H 9/00

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)

RUPAT, Esp@cenet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	RU 2251512 C1 (DAVYDKIN ALEKSANDR FEDOROVICH) 10.05.2005, the abstract, cited in the description	1-4
A	CZ 3077 U (SKODA, JADERNE STROJIRENSTVI) 17.05.1995, the abstract, figures 1, 2	1-4
A	RU 2061456 C1 (KACHANOVA LARISA VIKTOROVNA et al.) 10.06.1996, the abstract, figure 1	1-4
A	RU 2020913 C1 (SHKRABOV BORIS SEMENOVICH) 15.10.1994, figure 1	1-4
A	WO 2003/097445 A1 (LEITHOLE, PETER) 27.11.2003	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
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 April 2009 (02.04.2009)	16 April 2009 (16.04.2009)
Name and mailing address of the ISA/ Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- SU 1839983 **[0003] [0014]**
- RU 2251512 **[0004] [0014]**
- UA 26028 **[0014]**