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(54) INCUBATOR/REANIMATION TRANSFORMATION SYSTEM AND METHOD FOR TRANSFORMING SAID SYSTEM

(57) The invention relates to medical technology. The incubator/reanimation transformation system comprises a children's module which is mounted on a conveying trolley and has lateral panels and a hood, an IR emitter, and a panels of the module body and is divided in the axial plane into two parts, each of which is mounted in an articulated manner in the body of the children's module, and apertures are formed in the lateral surfaces of the hood. The IR emitter, a photo-therapeutic device and at least one box for storing accessories are arranged on the stand. In the method for transforming the incubator/reanimation system, the hood which is divided into two parts along the longitudinal plane is moved automatically, with rotation about the axes on which said parts are mounted, and with movement over/under the body of the children's module to the end upper/lower position, wherein the movement is controlled via a touch-sensitive display or additional control unit.

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Description

[0001] Two inventions combined in the application relate to medical equipment, namely, to neonatal equipment intended to exercise care and intensive therapy of new-born and weakened infants in departments of emergency and medical pediatrics, maternity homes and research institutes of maternity and childhood care.

[0002] Equipping of resuscitation wards with incubators-transformers allow to reduce by two times the areas required for placement of incubators and resuscitation systems and to sufficiently increase the quality of care of premature neonates having extremely low mass of body.

[0003] There is the known neonatal resuscitation complex made with a possibility of transformation into incubator for neonates and providing optimal conditions for resuscitation, care and nursing of neonates Giraffe OmniBed of Ohmeda Medical Inc., USA, Internet-sites, for example, www/bmt-medical.ru, that, as for essential characteristics in aggregate, is the nearest analog of the first invention of the claimed group of inventions.

[0004] The device contains the infant module with lateral panels and a hood installed on a transport trolley, stand for the hood relocation with illumination device and control unit with a monitor, module of equipment connection, box for accessories storage. In three lateral panels, installed in infant module with the help of hinges, there are made oval windows providing access to the patient during resuscitation activities and infant care procedures. Inside the hood there is placed an IR lamp with curtains. The hood is fixed on the upper bar that is installed on a stand with lifting mechanism for the hood relocation in vertical in relation to the neonate bed. The box for storage of accessories for the neonate care is installed under the infant module.

[0005] The disadvantages of the known device are:

- labour intensiveness of product manufacture from numerous assembly units;
- displacement of the infant module hood during opening and closing as well as its stay in open position above the bed is not a desirable psychological factor for the neonate, the ergonomic parameters of product are not provided;
- it is difficult to make disinfection of the hood with the IR lamp with curtains placed inside because it is located in upper position above the neonate bed.

[0006] The transformation of the known incubator device Giraffe OmniBed of Ohmeda Medical Inc., USA into the resuscitation system is made by the method known from the patent DK 1053736 that, as for essential characteristics in aggregate, is the nearest analog of the second invention of the claimed group of inventions. Transformation is made by pressing the button to start displacement in vertical plane in relation to the bed for neonate of the hood with heating device when changing the function between the lower position, in which it operates as an incubator for newborn, and the upper position, in which it operates as a heating device. To provide for easiness of medical operations three lateral panels can be folded manually, partially or completely. The process of transformation from resuscitation system to incubator is made in reverse order: the lateral panels will be installed, and further, when pressing the button, the hood starts moving from upper position to lower position until interaction with lateral panels.

[0007] The disadvantages of the known method are:

- necessity of manual manipulations to provide for complete transformation from incubator to resuscitation system and vice-versa, that is not desirable for observance of the medical staff hands sterility and also increases the interval of time, for example, from the beginning of the incubator transformation until the beginning of necessary resuscitation measures for the patient;
- operations for the hood opening and closing are carried out above the neonate's bed, that is dangerous for the patient in alarm situations, for example, with power supply disconnections, damages etc.

[0008] The task, to the solution of which each from the proposed inventions is directed, is an increase of performance features of incubator-resuscitation system for newborns.

[0009] When realizing the present inventions the achievable technical result consists in excluding the necessity of using manual operations for provision with full access to the patient and the hood stay above the patient bed during the product transformation, and also increase of easiness of work of the medical staff for the neonate care.

[0010] To solve the task and achieve the mentioned technical result in the known device of incubator-transformer for the newborns containing the infant module installed on transport trolley and that has lateral panels in which there are made the windows with doors and hood, IR-emitter, stand with illumination device and control unit with monitor, equipment connection module, control pedals, boxes for accessories storage,

- hood is made with lateral panels of single design,
- hood is divided in longitudinal axis into two parts each of them is installed in an articulated manner in parallel axes in the infant module body,
- windows with doors are made symmetrically on lateral surfaces of the hood,
- at least, one of the windows with door is made on a door which is mounted in articulated manner in the window of larger size intended for full access to the patient,
- a handrail is installed from the opposite side from the stand on the infant module body,
- an additional control unit with monitor is installed

from the opposite side from the stand on the infant module body,
- on the stand there are arranged IR-emitter and, additionally, phototherapy device,
- boxes for storage of accessories are arranged on the stand,
- monitor of basic control unit is made as sensory one,
- on the monitor there is installed a local illumination source.

[0011] In the described mechanism the mentioned technical effect is achieved by means of essential characteristics in full aggregate, including:

- performance of the hood by means of single design with lateral panels decreases the labor expenses during the product manufacture and assembly and also allows to exclude, as compared with the prototype, the manual operations and reduce the product transformation time, moreover, to provide for disinfection of the infant module the hood is easily dismounted, thus increasing the easiness and quality of performed works,
- division of the hood in longitudinal axis into two parts each of which is installed in articulated manner in the infant module body allows to open/close the hood and compactly place under the patient's bed,
- placement of the hood windows symmetrically on the hood lateral surfaces allows to have a comfortable access to the patient during medical activities carried out by the medical staff in the closed position of the hood,
- performance in lateral walls of the enlarged windows for access to the patient with the doors installed in articulated manner allows to take the neonate from incubator with the closed position of the hood,
- performance of the handrail from the opposite side from the stand on infant module body provides for easiness of the product relocation by the staff,
- the additional control unit with monitor, installed on the infant module body, arranged on the opposite side from the stand provides for control of basic functions of the incubator - resuscitation system transformer with the deactivated basic control panel, for example, at night time,
- the phototherapy device additionally installed on the stand increases a number of procedures built-in into the product that are required for the neonate care,
- placement of boxes for accessories storage on the stand allows to increase the accessories volume and quantity,
- performance of the monitor of the basic control panel as a sensory one with local illumination source increases easiness and velocity of the product control, provides for the intuitive user interface.

[0012] To solve the mentioned task and achieve the mentioned technical result in the known method of transformation

- of the incubator into resuscitation system for the newborn consisting in activation of the infant module hood displacement mechanism by control unit, infant module hood displacement with simultaneous switch on of the IR-emitter,

  - automatic displacement of the hood divided in longitudinal axis into two parts is realized by means of rotating around the axes onto which they are installed and displacement under the infant module body until the extreme lower position,
  - control of the hood displacement is realized via the sensory (touch-sensitive) display or additional control unit;

- of the resuscitation system into incubator for the newborn consisting in activation of the infant module hood displacement mechanism by control unit, infant module hood displacement with simultaneous switch off of the IR-emitter,

  - automatic displacement of the hood divided in longitudinal axis into two parts is realized by means of rotating around the axes onto which they are installed and displacement above the infant module body until the extreme upper position,
  - control of the hood displacement is realized via the sensory (touch-sensitive) display or additional control unit.

[0013] In the described method the mentioned technical effect is achieved by means of the invention essential characteristics in full aggregate, including:

- displacement of the hood from both sides of the infant module body and its stay in open position under the infant module body allows to improve the product ergonomic parameters, thus having excluded the manipulations over the neonate's bed for displacement and stay of the hood in open position,
- the displacement control is realized by means of the sensory display, thus increasing the velocity and easiness of the product control, provides for the intuitive user interface.

[0014] The described design of mechanism of the incubator-resuscitation system for the newborn allows to quickly transform the incubator into resuscitation system and back, herewith, the product provides for accurate temperature condition controlled by the processor, the preset humidity, temperature against air and baby's skin are automatically maintained, the weight is measured, the mattress slope and infant module height are adjusted. The incubator hood is made in dome form, without an-

gles, thus increasing the easiness of visualization without distortions of the neonate condition from any location of the medical staff.

[0015] The proposed inventions are explained by the drawings with the following representations:

Fig. 1 - Front view of the incubator-resuscitation system with closed hood (product operates as an incubator),
Fig. 2 - Right view in Fig. 1,
Fig. 3 - Front view of the incubator-resuscitation system with open hood (product operates as a resuscitation system),
Fig. 4 - Right view in Fig. 3.

[0016] The mechanism of incubator-transformer for the newborn contains the infant module 1 (Fig. 1, 2) installed on transport trolley 2 (Fig. 1, 2, 3, 4), stand 3 with IR-emitter 4, illumination device 5 and control unit 6 with monitor 7 that is performed with sensor screen and additional local illumination source 8, equipment connection module 9, boxes 10 for accessories storage. The compartment for a neonate is formed at installation of the hood 11 onto the infant module 1. The hood 11 is made dome-shaped (Fig. 2) with the lateral sides as a unified structure in form of the half of the horizontally orientated cylinder with ball segments on the ends (Fig. 1). The hood 11 is divided in longitudinal axis into two parts 12 and 13 (Fig. 2, 4) which of them is installed in articulated manner on parallel axes 14 and 15 (Fig. 1, 3) in the infant module body 1. On lateral surfaces of the hood 11 there are symmetrically performed six windows 16 with doors 17 on each. Two windows 16 are made on doors 18 and 19 installed with hinges in the windows of bigger size, that are made to provide for a possibility to take a neonate out from the incubator with the closed hood 11. On the infant module body 1, from the opposite side from the stand 3 there is installed an additional control unit 20 with monitor 21 as well as a handrail 22 for the product relocation. On transport trolley 2 there are mounted the pedals 23 that duplicate the product height adjustment control and also the castors 24 for the product relocation. So, control of the product transformation from incubator-transformer into resuscitation system and vice versa and also control of the product height adjustment can be made on monitor 7 and additional control unit 20. On stand 3 there is additionally installed a phototherapy device 25 and boxes 9 for accessories storage.

[0017] The proposed method of transformation of the incubator for the newborn into resuscitation system is to be carried out in the following sequence. When touching a respective button on monitor 7 display there will be switched on the control unit 6 of the hood 11 relocation mechanism of infant module 1 and the hood 11 will starts relocating at simultaneous switch on of IR-emitter 4. The hood 11 divided in longitudinal plane into two parts 12 and 13 starts rotation around the parallel axes 14 and 15 installed on both sides of infant module 1 and on which the hood parts 12 and 13 respectively are installed relocating under the infant module 1 body. At night time when the control unit with monitor 7 is switched off the control of the hood 11 relocation is made by pressing the button on the monitor control system 21. At occurrence of situations dangerous for a neonate the monitor 7 will automatically switch on and on its screen there will be displayed the information on the patient state and the equipment operation.

[0018] The devices operate as follows.

1. Incubator for the newborn.

[0019] The test system with micro processor monitoring control of the incubator operation parameters will be connected to the power source. The monitoring parameters values (temperature against air, temperature against skin, relative humidity, oxygen concentration, neonate mass etc) will be output to the monitor 7 of the control 6 and display unit placed on the incubator. The baby will be placed in the infant module 1. The incubator for the newborn automatically provides the adjustable heat gain, required air humidity and concentration of oxygen in infant module 1, body mass control.

[0020] The thermotherapy will be made by means of maintaining the present temperature of air inside infant module 1 of the incubator with adjustment of air temperature of patient's skin temperature, provision with required humidity of air, oxygen therapy by adjusting the air saturation with oxygen, infant module 1 slope adjustment to ensure the low or high position of the head. Standard or intensive care will be made by opening the doors for hands in the windows 16 or lateral doors 18 and 19 of the windows of larger size.

[0021] Moreover, when required, the following activities of intensive therapy will be carried out:

- blood transfusion,
- dosed administration of medical solutions,
- aspiration from upper airways,
- artificial ventilation of lungs,
- phototherapy,
- X-ray.

[0022] The following parameters are output to the monitor 7:

- air temperature,
- skin temperature (two sensors),
- air relative humidity,
- O_2 concentration,
- body mass,
- S_PO_2 measurement,
- arterial pressure measurement,
- CO_2 measurement.

[0023] The incubator is provided with internal memory allowing to record all monitored parameters during seven

days and output the trends to the monitor 7.

2. Resuscitation system.

[0024] During the incubator-transformer transformation into resuscitation system the IR-emitter 4 is automatically switched on for maintaining the temperature preset by medical staff. The necessary resuscitation activities will be carried out, and then, as required, by touching the button of sensor monitor 7 the resuscitation system within several seconds will be transformed into the incubator.

[0025] The realization of the claimed group of inventions is made with the use of progressive methods from high quality materials. All basic elements of design (hood, doors, infant module body, stand, boxes for accessories storage etc) are made with the use of the following technologies: plastic material pressure casting, stamping, mechanical treatment. During the product mounting they use mechanical assembly, electrical wiring and checkout.

[0026] During the infant module assembly the labor intensiveness of its manufacture has decreased, because, as compared with a prototype, there are removed the operations for installation of lateral panels and their checkout when installing onto the infant module 1 body. Each half 12 and 13 of the hood 11 is made by casting from high quality plastic as a single piece.

[0027] So, the use of the claimed technical solutions in the product improves its technological effectiveness of manufacture, permits to sufficiently increase the performance values of the incubator-resuscitation system for the newborn, including the easiness of maintenance, control and survey of the patients care modes, provision with hygienic requirements as well as is in compliance with the modern ergonomic requirements. Hereat, there are excluded the manual operations of the attending staff for a full access to the patient and stay of the hood over the patient during the product transformation into the open resuscitation system.

Claims

1. The incubator-resuscitation system transformer containing the infant module installed on the transport trolley and that has the lateral panels on which there are made the windows with the doors and hood, IR-emitter, stand with illumination device and control unit with monitor, equipment connection module, control pedals, boxes for accessories storage, *differing* by the fact that the hood is made with lateral panels as a single piece, that is divided in axial plane into two parts each of them is installed in articulated manner in the infant module body, hereat, the windows are made symmetrically on lateral surfaces of the hood and, at least, one of them is made on a door hinged in the window of larger size for an access to the patient, moreover, from the opposite side from the stand on the infant module body there are installed a handrail and an additional control unit with monitor and on the stand - IR-emitter, phototherapy device and, at least, one box for accessories storage.

2. The incubator-resuscitation system as per item 1 *differing* by the fact that the monitor of the basic control unit is made as a sensory one with local radiation source.

3. The incubator-resuscitation system as per item 1 *differing* by the fact that the hood parts divided in axial plane are hinged in parallel axes in the infant module body.

4. The method of transformation of the incubator-resuscitation system consisting in activation by the control unit of the infant module hood displacement mechanism, displacement of the infant module hood with simultaneous switch off/on of IR-emitter *differing* by the fact that automatic displacement of the hood divided in longitudinal axis into two parts is made by means of rotation around the axes on which they are installed and displacement over/under the infant module body until the extreme upper/lower position, hereat, the displacement control is made via the sensory display or additional control unit.

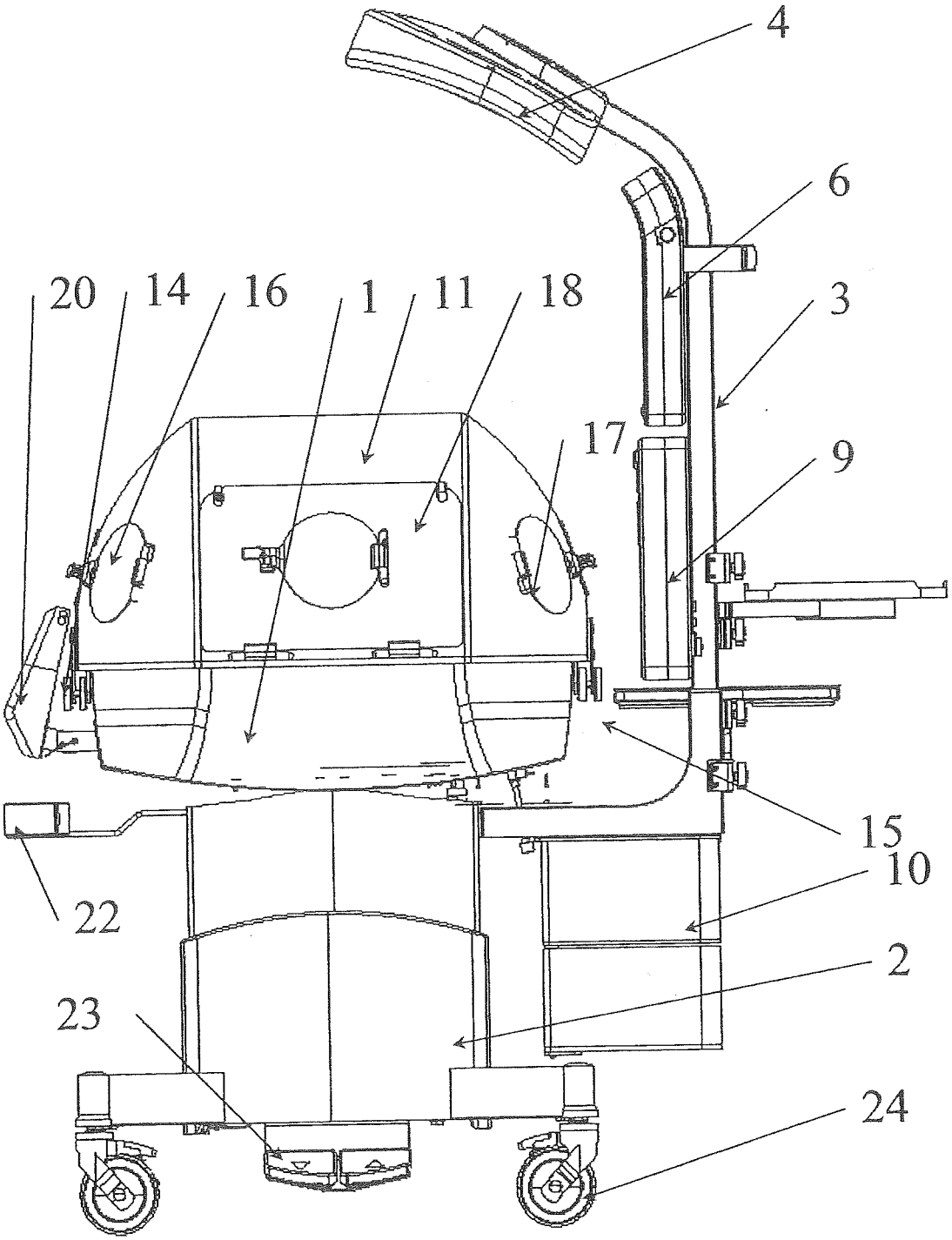


FIG. 1

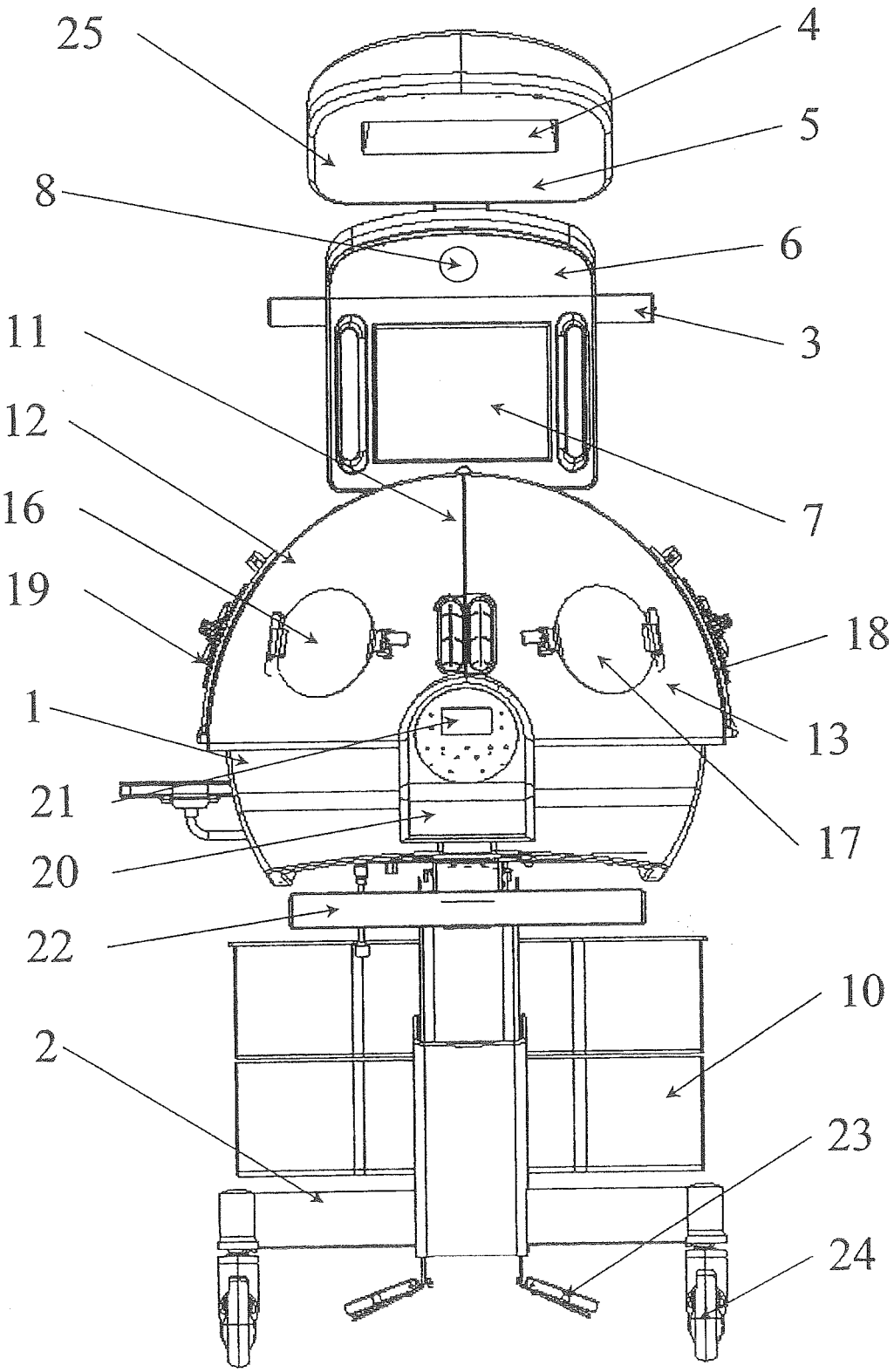


FIG. 2

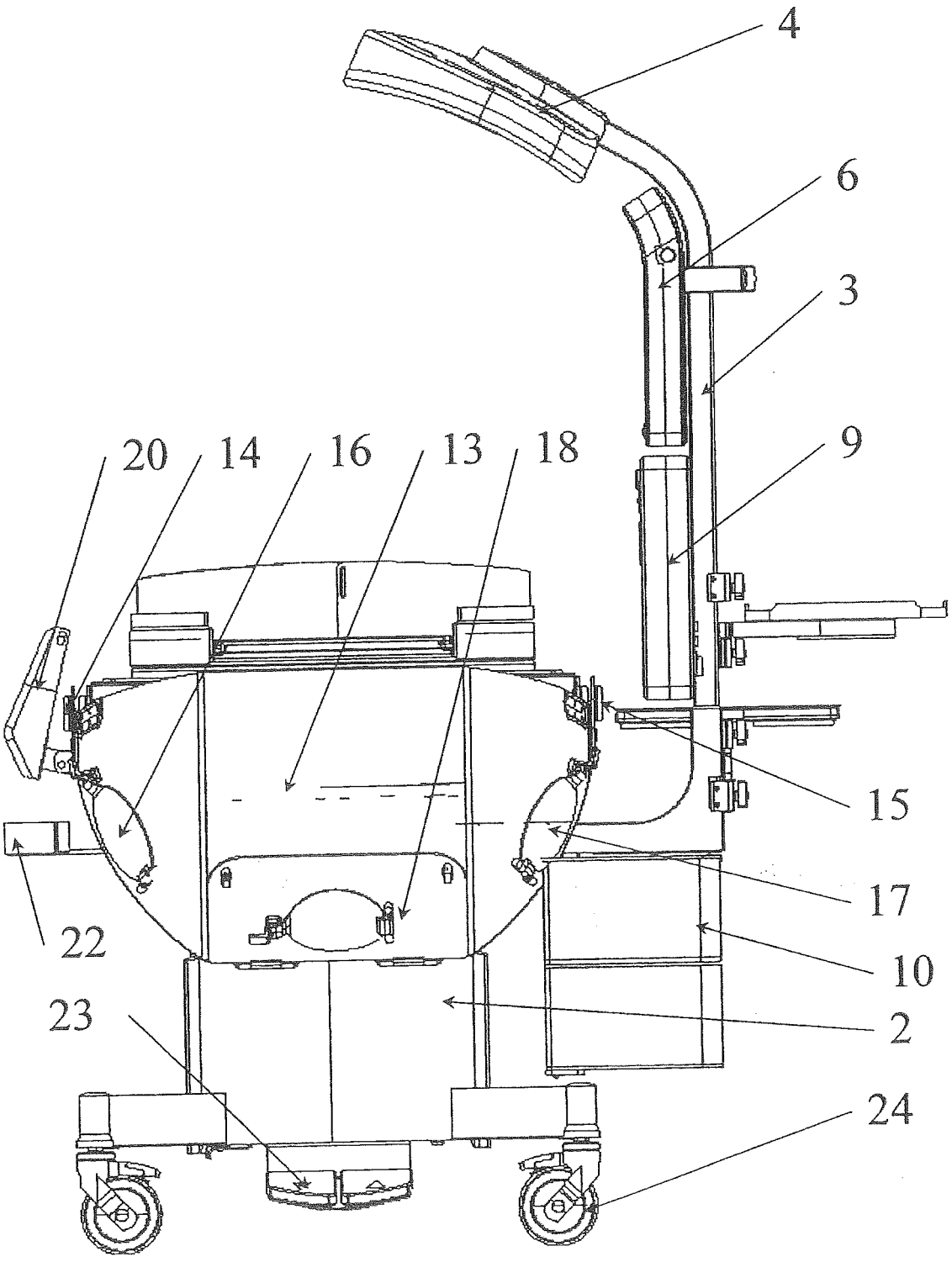


FIG. 3

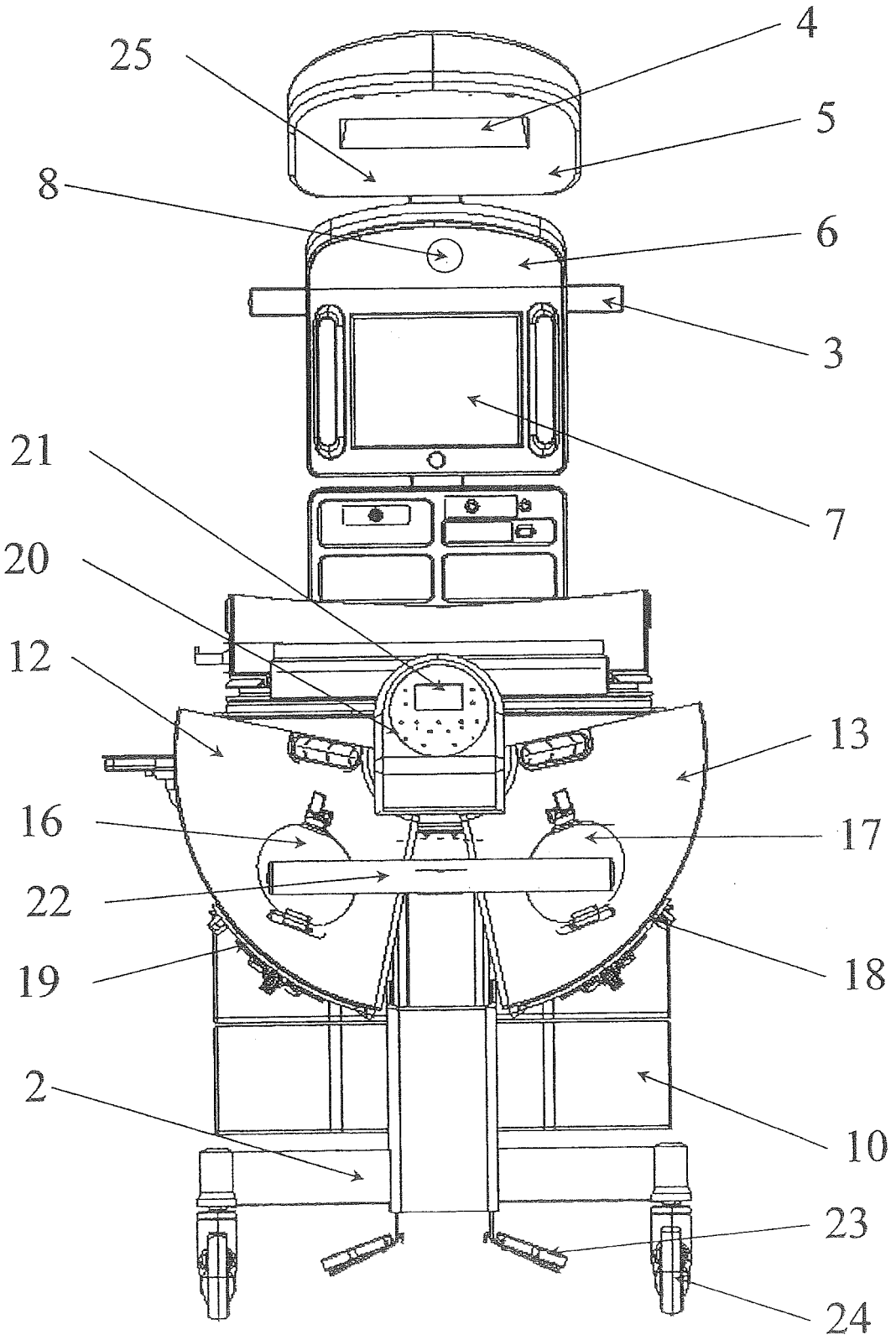


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU 2011/000829

A. CLASSIFICATION OF SUBJECT MATTER

A61G 11/00 (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)

A61G 11/00, 10/00

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)

PCT Online, USPTO DB, Esp@cenet, DWPI, CIPO (Canada PO), SIPO DB, AIPN, DEPATISnet, NCBI (PubMed), VINITI.RU, SCSML.FSSI.RU

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1053736 A2 (DATEX-OHMEDA, INC.) 22.11.2000	1-4
A	US 5797833 A (ATOM MEDICAL CORPORATION) 25.08.1998	1-4
A	RU 2140248 C1 (IVANOV ANDERY YULEVICH) 27.10.1999	1-4
A	RU 38583 U1 (FEDERALNOE GOSUDARSTVENNOE UNITARNOE PREDPRIYATIE "PROIZVODSTVENNOE OBEDINENIE "URALSKII OPTIKO-MEKHANICHESKII ZAVOD") 10.07.2004	1-4

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

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Date of the actual completion of the international search	Date of mailing of the international search report
05 March 2012 (05.03.2012)	29 March 2012 (29.03.2012)
Name and mailing address of the ISA/ Facsimile No.	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DK 1053736 **[0006]**