(19) DANMARK

Patent- og
Varemærkestyrelsen

(10) **DK/EP 3278106 T3**

(12) Oversættelse af
europæisk patentskrift

(51) Int.Cl.: ***A 61 M 1/02 (2006.01)***
*G 01 N 21/31 (2006.01)*
*G 01 N 33/49 (2006.01)*
***G 01 N 21/53 (2006.01)***
*G 01 N 21/59 (2006.01)*
***G 01 N 21/85 (2006.01)***
*G 01 N 21/84 (2006.01)*

(45) Oversættelsen bekendtgjort den: **2020-12-14**

(80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2020-10-07**

(86) Europæisk ansøgning nr.: **16729757.1**

(86) Europæisk indleveringsdag: **2016-03-24**

(87) Den europæiske ansøgnings publiceringsdag: **2018-02-07**

(86) International ansøgning nr.: **DE2016100145**

(87) Internationalt publikationsnr.: **WO2016155706**

(30) Prioritet: **2015-04-02 DE 102015004409**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **Fremgangsmåde og indretning til separering og analyse af blodbestanddele**

(56) Fremdragne publikationer:
**DE-A1- 19 530 969**
**DE-A1-102008 061 695**
**DE-A1-102011 008 460**
**US-A- 4 227 814**
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## Description

The invention relates to a method for separation and analysis of blood components according to claim 1 and a device for separation and analysis of blood components according to claim 13.

It has long been known prior art to separate blood into its components for further use. A known device for separating fluid mixtures, in particular blood, into the components thereof by means of centrifuging is described, for example, in DE 2308485 A1.

Particularly blood, inter alia as a result of low donation amounts, is a scarce and valuable resource and, not only for this reason, medically high quality requirements in the production or acquisition of blood reserves and with the qualitative monitoring in the storage process of the blood reserves have to be complied with.

At this time, there is no method available for non-invasive quality control of blood, or in particular of concentrated red cells. Until now, the quality was primarily ensured by the maintenance of high quality standards in blood treatment, equipment and the technical training of operators. Methods for quality control, as mainly used nowadays, are mostly based either on invasive tests, which lead to a destruction of at least 1% of the overall quantity, or on external visual examination by the operators. It is known that free haemoglobin is a measure for the state of the red blood cells and therefore an important parameter for the assessment of the quality and the usability of the concentrated red blood cells prior to the transfusion. In particular, the increase

or the change of the concentration of the free haemoglobin as a result of the breakdown of the red blood cells (haemolysis) can currently be carried out only by means of visual examination of the blood reserves. On the basis of this visual examination, which naturally is subject to uncertainty, blood reserves where the degree of haemolysis is suspected to be too high are no longer used.

From other fields of blood treatment, methods or devices are certainly known and contain methods for quality control which go beyond destructive tests or the pure visual examination. Thus, DE 10315484A1 discloses a method and a device for automatic filtration of substances which is in particular also suitable for leucocyte depletion of blood. For quality control of the filtrate produced, using a weight measurement unit a monitoring of the quantity and the quality of the filtrate produced is possible in this instance.

DE 102011008460A1 describes a method for producing a leucocyte-depleted filtrate. A blood preparation is directed from a supply container using gravitational force via a supply line through a leucocyte filter and subsequently into a collection container. An optical sensor measures the haemoglobin concentration after the leucocyte filter and a weighing system measures the weight of the collection container. Using the weight and the haemoglobin concentration, a processing unit establishes the total haemoglobin in the collection container.

An optical sensor measurement system which is suitable, using measurement with several light wavelengths, for determining concentrations of substances in non-homogeneous mixtures is described in DE102008081695A1.

US4969882A describes a method for separation of blood components, red blood cells are centrifuged in a first container and then directed via a connecting piece into a second container. The weight of the upper phase in the first container is determined by means of the haematocrit value and the overall weight of the non-separated red blood cells. Other methods and devices for processing blood are further known from US5958250A, US6294094B1, DE19530969A1, US4227814A and US4807676A.

An object of the invention is to avoid or reduce one or more disadvantages in the prior art. An object of the invention is in particular to allow an improved method for separating blood into the blood components thereof which in particular enables the components to be analysed in a simple and precise manner during the method, for example, for the purposes of quality monitoring.

It is further in particular an object of the invention to provide a device by means of which a method for separating blood into the blood components thereof can be carried out, which in particular enables the components to be analysed in a simple and precise manner during the method, for example, for the purposes of quality monitoring.

An object of the invention is in particular to provide a method which enables a non-invasive quality control of blood components, in particular of concentrated red blood cells, using the measurement or monitoring of the haemoglobin and/or lipid content.

The object of the invention is achieved with regard to the method with the features of the independent claim 1 and with regard to the device with the features of claim 13.

The method according to the invention and the device according to the invention can advantageously be supplemented by other embodiments, as described below. These advantageous embodiments are with regard to the method the subject-matter of the dependent claims 2-12 and with regard to the device the subject-matter of the dependent claims 14-15.

The method according to the invention comprises the features of claim 1.

This method has the advantage that in situ with respect to the separation process of the first phase from the second phase the haemoglobin and/or lipid content in the phase pumped into the second container can be determined. Complex analyses following the separation, which where applicable are still linked with a substance removal, are no longer necessary. Another advantage is based on the fact that the analysis is possible without any removal of substance. The closed system which the containers form with the connecting pieces thereby does not have to be opened or damaged. As a result of the analysis of the characteristic values of the haemoglobin and lipid content, other characteristics can further be associated with the blood components and permit a qualitative differentiation of the blood components.

There may preferably be provision for the recording of the optical measurement values for determining the haemoglobin and/or lipid content to be stopped as soon as the predetermined quantity of the phase pumped from the first

container into the second container has been pumped from the first container into the second container. Since the measurements are preferably carried out on the connecting piece by means of an optical transmission measurement, no further measurement is required after the pumping operation has ended.

In another preferred embodiment, the measurement values for determining the quantity of the phase pumped from the first container into the second container and the measurement values for determining the haemoglobin and/or lipid content are further processed in a processing unit. The further processing of the measurement values in an integrated evaluation unit affords the advantage that the characteristic values relating to the haemoglobin and lipid content can be directly established and can be associated with the respective reserves with blood components.

In another preferred embodiment, the established characteristic values are stored in a database so as to be able to be associated with the respective container with the separated phases and, together with an identification of the container with the separated blood components, are output on an output unit. The established characteristic values comprise the haemoglobin content and/or lipid content and are determined from the haemoglobin or lipid concentration and the quantity of blood components pumped into the second container. The concentration can be established with respect to a volume or with respect to the weight. As a result of the display of the established characteristic values, the user is advantageously supplied with information relating to the quality of the phase which has just been separated directly after the method has ended.

In another preferred embodiment, the characteristic values established from the measurement values can be output together with an identification of the container with the separated phases on labels, wherein the labels are suitable for being attached to the container with the separated phases. In order to ensure that the quality indications relating to the blood components pumped into the second container when the blood components are reused are also always available with the blood components themselves, all the information items characterising these blood components are printed on a label which can then be secured to the container itself.

In another particularly preferred embodiment, the connecting piece can be fixed in position, wherein the position of the fixed connecting piece is located in the beam path of an optical measuring device between a beam source and a detector. In another preferred embodiment, the correct fixing of the connecting piece is monitored by a sensor. In another particularly preferred embodiment, an error message is output when the connecting piece is not correctly fixed. In another preferred embodiment, the start of the pumping operation and/or the measurement operation can only be started when the connecting piece is correctly fixed. This has the advantage that, prior to the beginning of the method, it is ensured that the connecting piece is located close to the measurement location in a correct position. In the case of a misalignment of the connecting piece, incorrect measurement values could otherwise be established.

In another particularly preferred embodiment, the recording of the optical measurement values comprises the following steps:

- irradiating the phases with light from one or more light sources having a narrow-band wavelength range, wherein the blood components flow through the connecting piece during the recording of the optical measurement values,
- detecting the light after transmission through blood components in a detector.

In another particularly preferred embodiment, the optical measurement values for the wavelength-specific light attenuation are detected from the light detected in the detector. In this instance, it is quite particularly preferred for the content of haemoglobin in the phase directed through the connecting piece to be determined from the measurement values of the light attenuation resulting from the absorption of the blood components in the phase directed through the connecting piece and the measurement values for determining a throughflow quantity through the connecting piece. In the same manner, it is quite particularly preferable for the lipid content in the phase directed through the connecting piece to be determined from the measurement values of the light attenuation resulting from the scattering of the blood components in the phase directed through the connecting piece and the measurement values for determining a throughflow quantity through the connecting piece. As a result of the contactless measurement in transmission, a measurement precision is ensured. In addition, the closed system is not opened for a sample removal. This reduces the risk of contamination considerably.

In another preferred embodiment, the optical measurement values and the measurement values for determining the throughflow quantity through the connecting piece are recorded multiple times. In this instance, it may be particularly preferable for the haemoglobin and/or lipid

content in the quantity which is directed through the connecting piece to be determined by integration or addition of the measurement values. In the case of inhomogeneities in the distribution of the lipid or haemoglobin content in the phase which is intended to be pumped into the second container, using a single measurement no statement can be made relating to the overall content of haemoglobin and/or lipids. It is therefore advantageous for these measurements to be carried out in each case with respect to a part-volume of the phase which is intended to be pumped into the second container or to carry out a plurality of temporally sequential measurements. Using an addition or an integration method, the overall contents of haemoglobin and lipid can then be established.

In another preferred embodiment, the phase directed through the connecting piece is irradiated with light from at least two light sources, wherein the light from the at least two light sources is absorbed by the haemoglobin to a different extent. In this instance, it may be particularly preferable for the measurement values of the light with the wavelength which is absorbed less by the haemoglobin to be used to determine the scattering of the light after irradiation of the phase directed through the connecting piece. As a result of the absorption by the haemoglobin to different extents, it is advantageously ensured that, even with a different haemoglobin content, a high level of measurement precision can be achieved.

The device according to the invention comprises the features of claim 13.

The device according to the invention affords the advantage that, in order to analyse the characteristic values of the blood components, no additional method step which is temporally and spatially separate from the separation process has to be carried out. This helps to save time and costs.

In another preferred embodiment, the optical sensor unit comprises an optical unit and the evaluation unit. In this instance, it is particularly preferable for the optical unit to comprise a detector and one or more narrow-band light sources, wherein the light sources are arranged rotationally symmetrically about the optical axis of the detector. In a quite particularly preferred manner, the optical unit comprises a beam splitter and a second detector and/or an aperture for narrowing the beam range of the individual light sources to an overlapping beam cross-section of the light sources and/or a beam splitter and a second detector for reference measurement and/or additional optical elements. In another preferred embodiment, the optical unit is arranged in direct proximity to the device for fixing. In another preferred embodiment, the optical unit is suitable for measuring light attenuation as a result of the scattering and/or the absorption of blood components in the connecting piece.

In another preferred embodiment, the evaluation unit is connected to a device for outputting and/or storing the measurement values and/or characteristic values. In this instance, it is particularly preferable for the device for outputting and/or storing the measurement values and/or characteristic values to comprise a display and/or a printer and/or a database.

The invention is explained in greater detail below with reference to a plurality of embodiments. In the drawings:

Figure 1 shows a method for separating blood components and the analysis thereof,
Figure 2 shows a method for separating blood components and the analysis thereof with output of the analysis data,
Figure 3 shows a method for separating blood components and the analysis thereof with monitoring of the correct positioning of the object to be examined,
Figure 4 shows a method for separating blood components and the analysis thereof with monitoring of the process sequence,
Figure 5 shows a device for carrying out a method for separating and analysing blood components,
Figure 6 shows an optical sensor unit for analysis of blood components, evaluation, storage and output of the results,
Figure 7 shows an optical unit for analysing blood components.

Figure 1 shows the method steps of the method 1 according to the invention for separation of blood components and analysis of the blood components. In methods of this type, in blood reserves after the removal or the blood donation process, the blood components are separated in their container. To this end, there is mostly used a centrifuging process in which the blood is separated into a light phase, the serum or plasma and a heavy phase, mainly the cells which are contained in the blood. After the centrifuging, in a first container 23 which is a blood bag in most cases, the blood components are present in two phases. The method 1 according to the invention is used to separate these two phases from each other, wherein, during the separation process, the blood components are examined in terms of their composition in an analysis process. This process begins with the start of a

pumping process 11 by means of which one of the phases is pumped from a first container 23, in which both phases are present in a separated state after the centrifuging process, via a connecting piece 29 into a second container 24. The connecting piece 29 connects the first container 23 to the second container 24. The first container and second container 23, 24 together form with the connecting piece 29 a closed system. In an alternative embodiment, the closed system may comprise additional containers 23, 24 and connecting pieces 29. Pumps in the context of the invention are intended to be understood to be all means which serve to convey blood components from the first container 23 into the second container 24. This may be carried out, for example, by means of the change of the pressure relationships in the first container and/or second container 23, 24. The pressure relationships in the containers 23, 24 may be changed by a reduced pressure being produced in the second container 24, as a result of which the blood components are drawn into the second container 24. It is further possible to produce an excess pressure in the first container 23 and thus to press the blood components into the second bag 24. This can be carried out in a simple manner by the first container 23 being compressed. Directly after the start of the pumping process 11, the recording of the measurement values is started for determining the quantity of the blood components 12 pumped from the first container 23 into the second container 24. Furthermore, after the start of the pumping process 11, the recording of the measurement values for analysis of the blood components 13 pumped from the first blood container 23 into the second container 24 is started. As soon as the provided quantity of the phase which is intended to be pumped into the second container 24 is reached, the pumping process is ended 14.

A method for separating blood components and simultaneously analysing the separated phases 10 is illustrated in Figure 2. This method 10 is based on the method 1 described in Figure 1 and is supplemented by additional method steps 105, 107, 108, 109. The supplemented method steps 105, 107, 108, 109 can each be supplemented individually in relation to the method 1 described in Figure 1. In a first optional method step, when the pumping operation 14, 104 is ended, the recording of the measurement values is also ended. In spite of the separation of the blood components into two phases after the centrifuging, non-homogeneous distributions of the blood components, such as haemoglobin content or lipid content, may be present in the individual phases. The measurement values for determining the blood components are therefore recorded multiple times 103. Since, particularly with a non-homogeneous distribution of the blood components, the measurement values which are recorded multiple times to analyse the blood components in order to determine the overall content of the blood components in the quantity which is pumped into the second container 24 are dependent on the quantity of the separated phase which has already been pumped at this time past the optical unit 25, the quantities pumped into the second container are also measured several times 104. In a particularly preferred embodiment, the measurements of the pumped quantity 104 and the measurements for analysis of the blood components 103 are carried out in such a manner that a measurement value of the pumped quantity can be associated with each measurement value for analysis of the blood components. From the recorded measurement values for analysis of the blood components 103 and in order to determine the quantity 104 of the separated phase pumped into the second container 24, in another method step in an

evaluation unit 252 the characteristic values of the blood components pumped into the second container are determined 106.

In a preferred embodiment of the invention, the measurements for analysis of the blood components 103 are carried out multiple times periodically. With a constant pump power, each individual measurement for analysing the blood components 103 is then correlated with a quantity of blood components pumped into the second container in the respective time period. In a particularly preferred embodiment of the invention, the individual values established in this manner are added or used for an integration in order to establish the overall quantities of haemoglobin and/or lipid in the quantity of blood components pumped into the second container 24. In another particularly preferred embodiment, the quantity 102 pumped into the second container 24 is also periodically determined, wherein the period length of the determination of the pumped quantity 102 is equal to the period length of the measurement for analysis of the blood components 103. A measurement value for analysis of the blood components 103 can thus be associated with each measurement value for determining the pumped quantity 102. The determination of the overall haemoglobin and/or lipid contents is then carried out again by means of integration or addition of the individual results. If the quantity of the phase 102 pumped into the second container 24 is determined at a different location from the location where the measurements for analysis of the blood components 103 are carried out, an error occurs in the association of the individual measurement values. Therefore, in another preferred embodiment of the invention, as a result of a corresponding correction each individual measurement for analysing the blood components 103 is associated with the

volume element or quantity element on which the measurement has taken place.

In another optional method step, the consequently established characteristic values of the blood components pumped into the second container 24 are stored in a database 107. The storage may include the established measurement values and/or the calculated characteristic values. The measurement values and/or characteristic values are associated in the database with the identification of the respective blood reserve. The stored data can be retrieved again from the database. In another embodiment of the invention, the established characteristic values are output on a display device. In another preferred embodiment of the invention, the characteristic values are printed out together with the identification of the blood reserve on a label, wherein the label can be secured to the blood reserve itself. If the characteristic values of the blood reserve are already known from preceding measurements prior to the separation of the blood components, in another particularly preferred embodiment the characteristic values for the blood components remaining in the first container 23 are established from the characteristic values of the blood reserve prior to carrying out the method 1, 10 according to the invention and the characteristic values established in the method 1, 10 for the blood components pumped into the second container 24.

In another embodiment of the invention, the correct positioning of the portion of the container 23, 24 used for the analysis of the blood components or the connecting piece 29 is monitored (Figure 3). In the present example, this is carried out via a mechanical sensor 27 which transmits to the control unit 20 an electronic signal which identifies when

the portion of the container 23, 24 used for the analysis of the blood components or the connecting piece 29 is correctly positioned. In a preferred embodiment, the pumping operation can only be started when via the sensor for monitoring the correct positioning a corresponding signal reaches the control unit 20. Controlling the pumping operation 111 in this manner ensures that no incorrect measurement values as a result of deviations in the arrangement of the portion of the container 23, 24 used for the analysis of the blood components or the connecting piece 29 are recorded. The interrogation relating to the correct positioning can also be carried out continuously. Alternatively, with correct positioning by the sensor 27, a signal for releasing the process 1, 10 can be triggered.

Figure 4 illustrates a part-method for controlling the pumping operation. After the start of the pumping operation 11, 101 and the recording of the measurement values for determining the pumped quantity 12, 102 and for analysing the blood components 13, 103, it is verified whether the provided quantity has already been pumped into the second container 24. The provided quantity is either predetermined by a predetermined requirement of the user or determined by the phase previously separated by means of centrifuging being pumped completely into the second container. With a predetermined quantity, the quantity already pumped into the second container 24 is monitored 112 and the pumping operation is ended 14, 104 as soon as the predetermined quantity is reached. If one of the phases, for example, separated from each other in the first container 23 by means of centrifuging, should be almost completely pumped into the second container 24, it is established when the time is reached at which the two phases are almost completely

separated from each other in the respective containers 23, 24. The monitoring may, for example, be carried out by means of an optical sensor which via the different optical properties of the separated phases establishes the position of the boundary between the two phases and transmits a signal to the control unit 20 when the two phases are almost completely divided over the two containers. Via the control unit 20, the pumping process is then ended 14, 104. In a particularly preferred embodiment of the invention, in order to monitor the boundary between the mutually separated phases, the sensor unit for recording the measurement values for analysis of the blood components 25, 251 is used. Alternatively, a separate optical sensor may also be used. Furthermore, it is also possible after the centrifuging to determine the quantity of the blood components to be pumped into the second container 24 and after reaching the pumped quantity to end the pumping process 14, 104.

Figure 5 shows the structure of the device for separating blood components and analysis of blood components 2. The device 2 comprises a first device 21 for receiving a first blood container 23 and a second device 22 for receiving a second blood container 24, wherein the blood containers 23, 24 are connected by means of a connecting piece 29. Furthermore, the device for separating blood components and analysis of blood components 2 comprises an optical sensor unit 25 which is suitable for detecting optical measurement values of the blood components pumped into the second container 24 and a device 27 for fixing the connecting piece 29. Furthermore, the embodiment according to the invention comprises a device 28 for pumping blood components from a first container 23 into a second container 24 and a device for measuring the quantity of the blood components 26, 253

pumped from the first container into the second container. The device for pumping 28, the optical sensor unit 25 and the device for measuring the quantity of the blood components 26, 253 pumped from the first container into the second container are connected to a control unit 20. In a preferred embodiment, the optical unit 25 is arranged in the direct vicinity of the fixing device 27.

The structure of the optical sensor unit 25 is illustrated in Figure 6. The optical sensor unit 25 comprises an optical unit 251 for recording the measurement values for analysis of blood components, an evaluation unit 252 for evaluating detected measurement data and a memory 254 for storing measurement data and/or characteristic values. The optical sensor unit 25 is further connected to a device for determining the quantity of blood components 26, 253 pumped from a first container into a second container. In a preferred embodiment, the optical sensor unit 25 is connected to a display device 255 and a printer 256 for printing out printed labels. In a particularly preferred embodiment of the invention, the optical sensor unit is connected to a database 257 which can be accessed from external locations in order to interrogate the established measurement values or characteristic values determined from them. In another preferred embodiment of the invention, the control unit 20 and the evaluation unit 252 are a single unit.

Figure 7 shows the structure of the optical unit 251. A plurality of monochrome and/or narrow-band light sources 35 are arranged in a rotationally symmetrical manner about the optical axis 32 of a detector 31. The optical unit 251 is in this instance arranged in such a manner that the portion of the container 23, 24 or the connecting piece 29 which is used

for analysis of the blood components is located in the beam path of the optical unit 251 and is irradiated by the light incident on the detector 31. Preferably, the region which is irradiated is also rotationally symmetrical with respect to the optical axis 32, whereby an identical optical path length is produced for all the light sources 35. In a preferred embodiment, the light sources 35 are arranged close to the optical axis 32. This leads to only small deviations of the sample region irradiated by the light incident on the detector 31. Furthermore, in a preferred embodiment, a wide-band detector 31 is used. In a particularly preferred embodiment, an aperture 34 is used in order to limit the beam cross-section and thus to ensure that the beam cross-section is limited in the region of the sample to the cross-section in which the beam cross-sections of all the light sources 35 overlap each other. In another particularly preferred embodiment of the invention, alternatively or additionally to the aperture 34 a lens which bundles the largest possible quantity of light on the sample is arranged. In another particularly preferred embodiment of the invention, using a beam splitter which is arranged upstream of the sample, a part-beam is decoupled and directed directly onto a second detector 31. As a result of this arrangement, the decoupled part-beam is used for a reference measurement.

**LIST OF REFERENCE NUMERALS**

1, 10 method for separating blood components and analysis of the blood components

11, 101 Start of the pumping operation of blood components from one container into another container

12, 102 Recording of measurement values to determine the quantity pumped into the second container

13, 103 Recording of optical measurement values to determine the haemoglobin and/or lipid content

14, 104 Ending of the pumping operation of blood components

105 Ending of the recording of measurement values

106 Determination of characteristic values of the blood components from the recorded measurement values in a processing unit

107 Storing the characteristic values of the blood components and the identification of the container in a database

108 Outputting the characteristic values of the blood components in a display

109 Outputting the characteristic values of the blood components on a label

110 Monitoring the correct fixing of the connecting piece between the two containers using a sensor

111 Control of the start of the pumping operation

112 Control of the ending of the pumping operation

2 Device for separating blood components and analysis of blood components

20 Control unit

21 Device for receiving a first container

22 Device for receiving a second container

23 First container

24 Second container

25 Optical sensor unit

26, 253 Device for determining the quantity pumped into the second container

27 Device for fixing the connecting piece between the first and the second container

28 Device for pumping blood components from a first container into a second container

29 Connecting piece between a first container and a second container

251, 3 Optical unit

252 Control and evaluation unit

254 Memory

255 Display device

256 Printer

257 Database

31 Detector

32 Optical axis

33 Beam splitter

34 Aperture

35 Light source

## Patentkrav

**1.** Fremgangsmåde (1, 10) til separering af blodbestanddele, der befinder sig i en første beholder (23) og er separeret i en let fase og en tung fase, og analyse af blodbestanddelene, omfattende følgende fremgangsmådetrin:
pumpning (11, 101) af en af de to faser fra den første beholder (23) over i en anden beholder (24), hvor den første beholder (23) er forbundet med den anden beholder (24) via et forbindelsesstykke (29),
optagelse (12, 102) af måleværdier til bestemmelse af mængden af fasen, som pumpes fra den første beholder (23) over i den anden beholder (24),
optagelse (13, 103) af optiske måleværdier til bestemmelse af hæmoglobin- og/eller af lipidindholdet af fasen, som pumpes fra den første beholder (23) over i den anden beholder (24), under pumpningen (11, 101) af en af de to faser fra den første beholder (23) over i den anden beholder (24),
fastlæggelse af karakteristiske værdier af fasen, som pumpes gennem forbindelsesstykket (29), ud fra måleværdierne til bestemmelse af mængden af fasen, som pumpes fra den første beholder (23) over i den anden beholder (24), og de optiske måleværdier til bestemmelse af hæmoglobin- og/eller lipidindholdet, hvor de karakteristiske værdier omfatter hæmoglobin- og/eller lipidindholdet.

**2.** Fremgangsmåde (1, 10) ifølge krav 1, **kendetegnet ved, at** optagelsen af de optiske måleværdier til bestemmelse af hæmoglobin- og/eller lipidindholdet stoppes, så snart en tilvejebragt mængde af fasen, som pumpes fra den første beholder (23) over i den anden beholder (24), er blevet pumpet fra den første beholder (23) over i den anden beholder (24).

**3.** Fremgangsmåde (1, 10) ifølge krav 1 eller 2, **kendetegnet ved, at** de karakteristiske værdier af fasen, som pumpes over i den anden beholder (24), lagres i en database (257).

**4.** Fremgangsmåde (1, 10) ifølge krav 3, **kendetegnet ved, at** de karakteristiske værdier sammen med en identifikator af den anden beholder (24) med den pumpede fase udlæses på en visningsindretning (255, 256) og printes ud

på en etiket, hvor etiketten er egnet til at blive fastgjort på den anden beholder (24) med den pumpede fase.

**5.** Fremgangsmåde (1, 10) ifølge et eller flere af de foregående krav 1 til 4, **kendetegnet ved, at** forbindelsesstykket (29) er fikseret i strålegangen af en optisk måleindretning (251, 3) mellem en lyskilde (35) og en detektor (31).

**6.** Fremgangsmåde (1, 10) ifølge et eller flere af de foregående krav 1 til 5, **kendetegnet ved, at** en korrekt fiksering af forbindelsesstykket (29) overvåges af en sensor, hvor der afgives en fejlmeddelelse, hvis forbindelsesstykket (29) ikke er fikseret korrekt, og/eller hvor en start af pumpningen kun kan startes, hvis forbindelsesstykket (29) er fikseret korrekt.

**7.** Fremgangsmåde (1, 10) ifølge et eller flere af de foregående krav 1 til 6, **kendetegnet ved, at** optagelsen af de optiske måleværdier omfatter følgende trin:
bestråling af den pumpede fase med lys fra en eller flere lyskilder (35) med et smalbåndet bølgelængdeområde og
detektion af lyset efter transmission gennem fasen, som pumpes over i den anden beholder (24), i en detektor (31).

**8.** Fremgangsmåde (1, 10) ifølge krav 7, **kendetegnet ved, at** der ud fra lyset, som er detekteret i detektoren (31), registreres optiske måleværdier for den bølgelængdespecifikke lysdæmpning.

**9.** Fremgangsmåde (1, 10) ifølge krav 8, **kendetegnet ved, at** indholdet af hæmoglobinet i fasen, som pumpes gennem forbindelsesstykket, bestemmes ud fra de optiske måleværdier af den bølgelængdespecifikke lysdæmpning på grund af en absorption af blodbestanddelene i fasen, som pumpes gennem forbindelsesstykket, og måleværdierne til bestemmelse af mængden af den pumpede fase i den anden beholder (24).

**10.** Fremgangsmåde (1, 10) ifølge krav 8 eller 9, **kendetegnet ved, at** lipidindholdet i fasen, som pumpes gennem forbindelsesstykket, bestemmes ud

fra de optiske måleværdier af den bølgelængdespecifikke lysdæmpning på grund af en spredning af blodbestanddelene i fasen, som pumpes gennem forbindelsesstykket, og måleværdierne til bestemmelse af mængden af den pumpede fase i den anden beholder (24).

**11.** Fremgangsmåde (1, 10) ifølge et eller flere af de foregående krav 1 til 10, **kendetegnet ved, at** de optiske måleværdier og måleværdierne til bestemmelse af mængden af den pumpede fase registreres flere gange, hvor især hæmoglobin- og/eller lipidindholdet i den pumpede fase fastslås ved integrering af de optiske måleværdier.

**12.** Fremgangsmåde (1, 10) ifølge et eller flere af de foregående krav 1 til 11, **kendetegnet ved, at** fasen, som pumpes gennem forbindelsesstykket (29), gennemstråles med lys fra mindst to lyskilder (35), hvor et lys fra de mindst to lyskilder (35) absorberes af hæmoglobinet med forskellig kraft, og hvor der med henblik på at fastslå en spredning af lyset efter gennemstråling af fasen, som pumpes gennem forbindelsesstykket (29), anvendes måleværdier af lyset med den pågældende bølgelængde, som absorberes mindre af hæmoglobinet.

**13.** Indretning (2) indrettet til separering af blodbestanddele, der befinder sig i en første beholder (23) og er separeret i en let fase og en tung fase, og analyse af blodbestanddelene i henhold til fremgangsmåden ifølge et eller flere af kravene 1 til 12, hvor indretningen (2) omfatter følgende elementer:
den første beholder (23) og en anden beholder (24), en indretning til optagelse (21) af den første beholder (23), i hvilken indretning den første beholder (23) er optaget,
en indretning til optagelse (22) af den anden beholder (24), i hvilken indretning den anden beholder (24) er optaget,
en indretning (28) indrettet til pumpning af en af de to faser fra den første beholder (23) over i den anden beholder (24),
et forbindelsesstykke (29),
en indretning til fiksering (27) af forbindelsesstykket (29) mellem den første beholder (23) og den anden beholder (24), i hvilken indretning forbindelsesstykket (29) er optaget,

en optisk sensorenhed (25), indrettet til optagelse af optiske måleværdier til bestemmelse af hæmoglobin- og/eller lipidindholdet af fasen, som pumpes fra den første beholder (23) over i den anden beholder (24), under pumpningen af en af de to faser fra den første beholder (23) over i den anden beholder (24), indretning (26, 253) indrettet til bestemmelse af mængden af fasen, som pumpes fra den første beholder (23) over i den anden beholder (24), og
en evalueringsenhed (252) indrettet til bestemmelse af karakteristiske værdier af fasen, som pumpes gennem forbindelsesstykket (29), ud fra måleværdierne til bestemmelse af mængden af fasen, som pumpes fra den første beholder (23) over i den anden beholder (24), og de optiske måleværdier til bestemmelse af hæmoglobin- og/eller lipidindholdet, hvor de karakteristiske værdier omfatter hæmoglobin- og/eller lipidindholdet.

**14.** Indretning (2) ifølge krav 13, **kendetegnet ved, at** den optiske sensorenhed (25) omfatter en optisk enhed (251) og evalueringsenheden (252), hvor den optiske enhed (251)
(a) omfatter en detektor (31) og flere smalbåndede lyskilder (35), hvor de flere smalbåndede lyskilder (35) er anbragt rotationssymmetrisk omkring en optisk akse (32) af detektoren (31), hvorved der for alle af de flere smalbåndede lyskilder (35) fås en identisk optisk længde og/eller
(b) er anbragt i umiddelbar nærhed af indretningen til fiksering (27), og/eller
(c) er egnet til at måle en lysdæmpning på grund af en lysspredning og/eller en absorption af blodbestanddele i forbindelsesstykket (29).

**15.** Indretning (2) ifølge krav 13 eller 14, som omfatter:
en indretning til udlæsning og/eller lagring af måleværdierne og/eller karakteristiske værdier, som er forbundet med evalueringsenheden (252), hvor indretningen til udlæsning og/eller lagring af måleværdierne og/eller de karakteristiske værdier omfatter et display (255) og/eller en printer (256) og/eller en database (257).

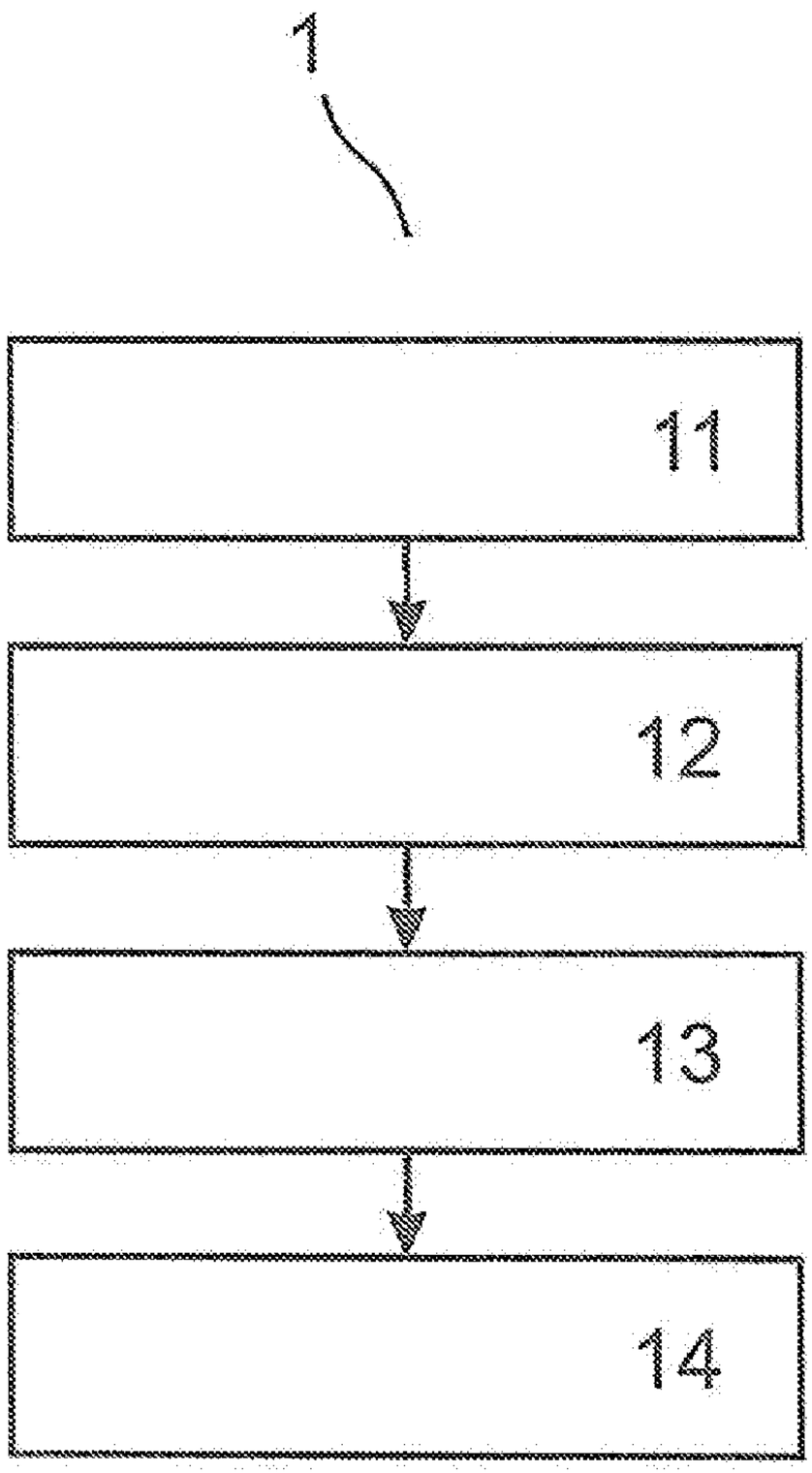


Fig. 1

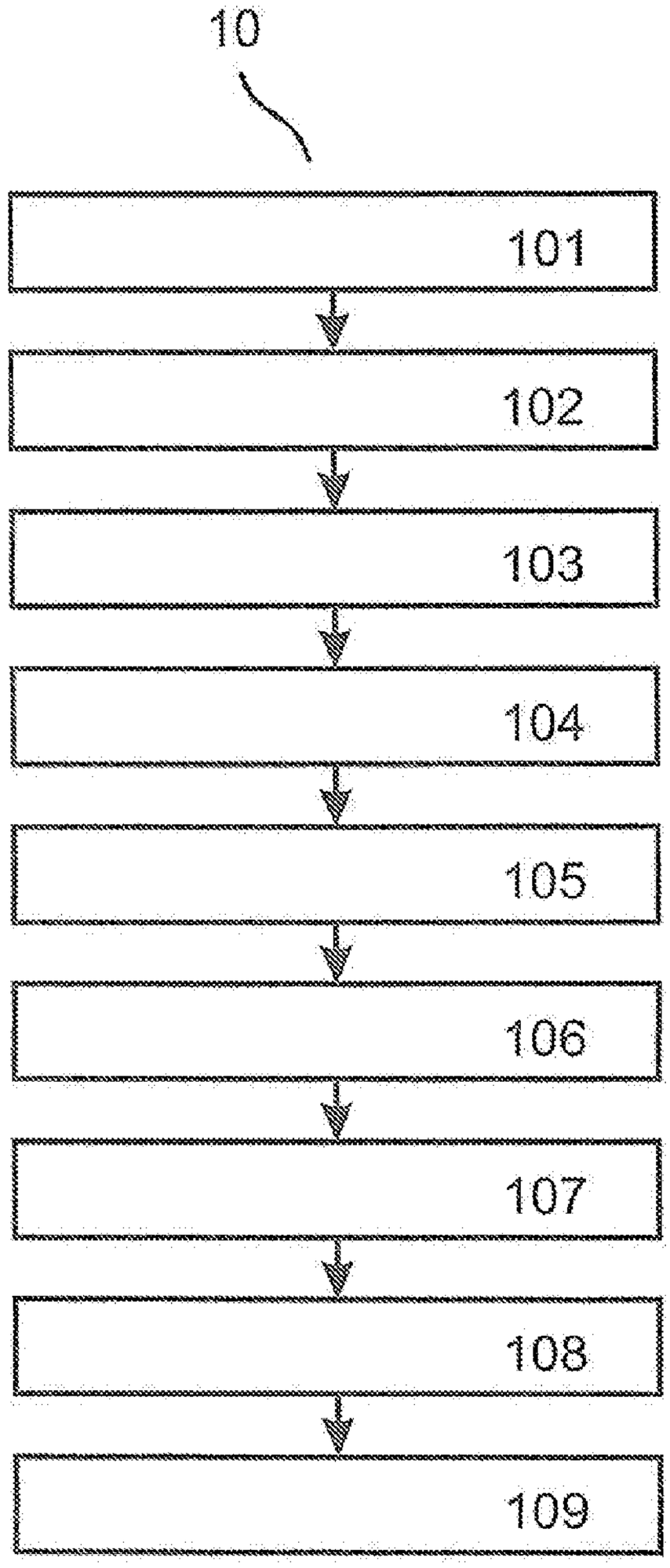


Fig. 2

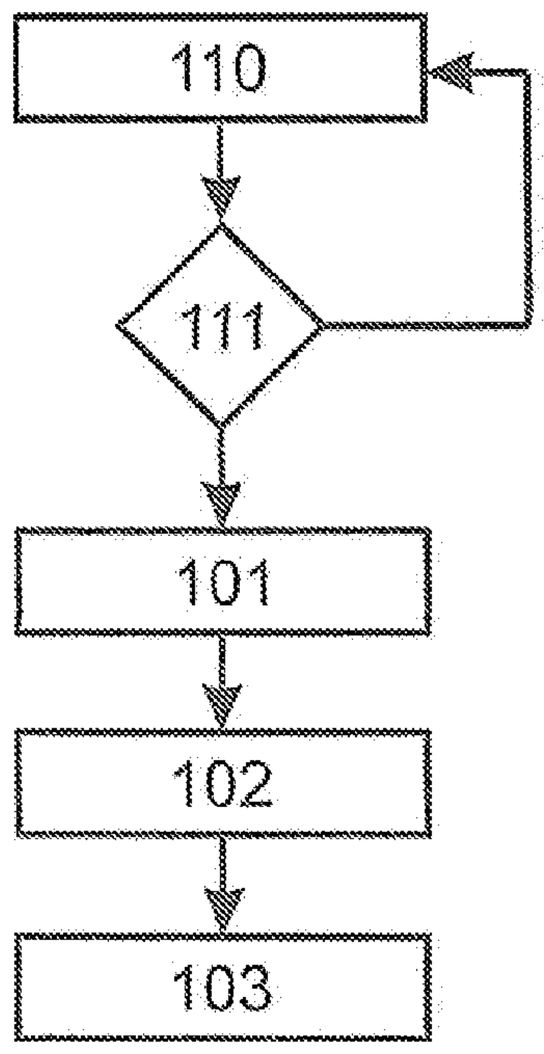


Fig. 3

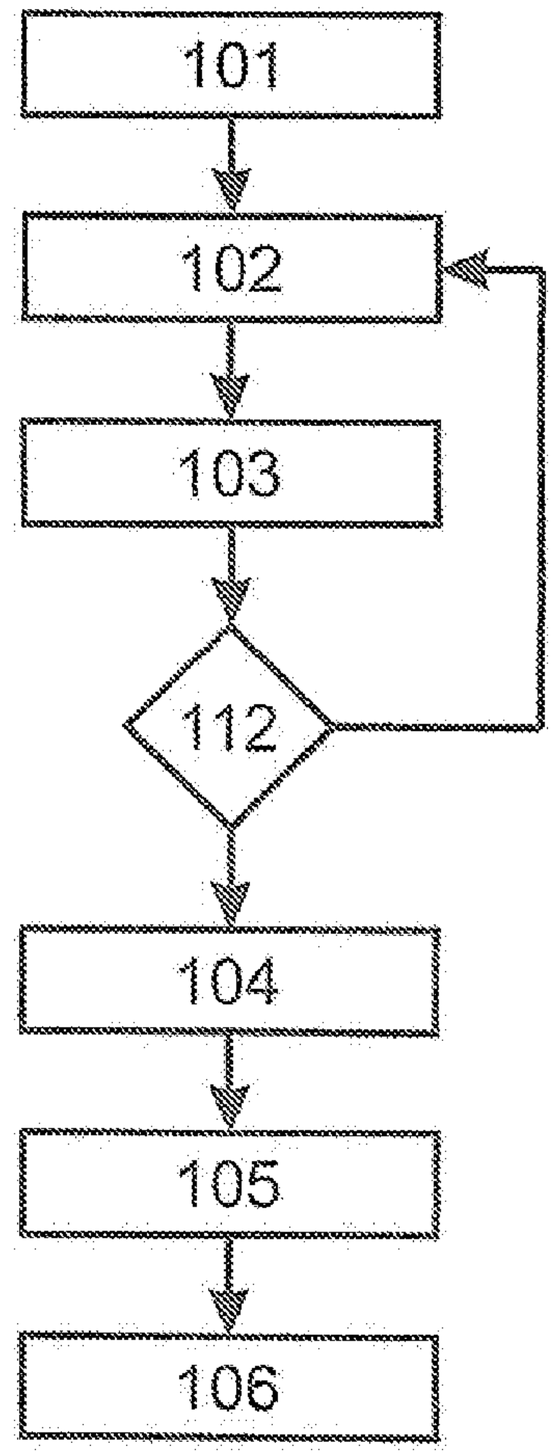


Fig. 4

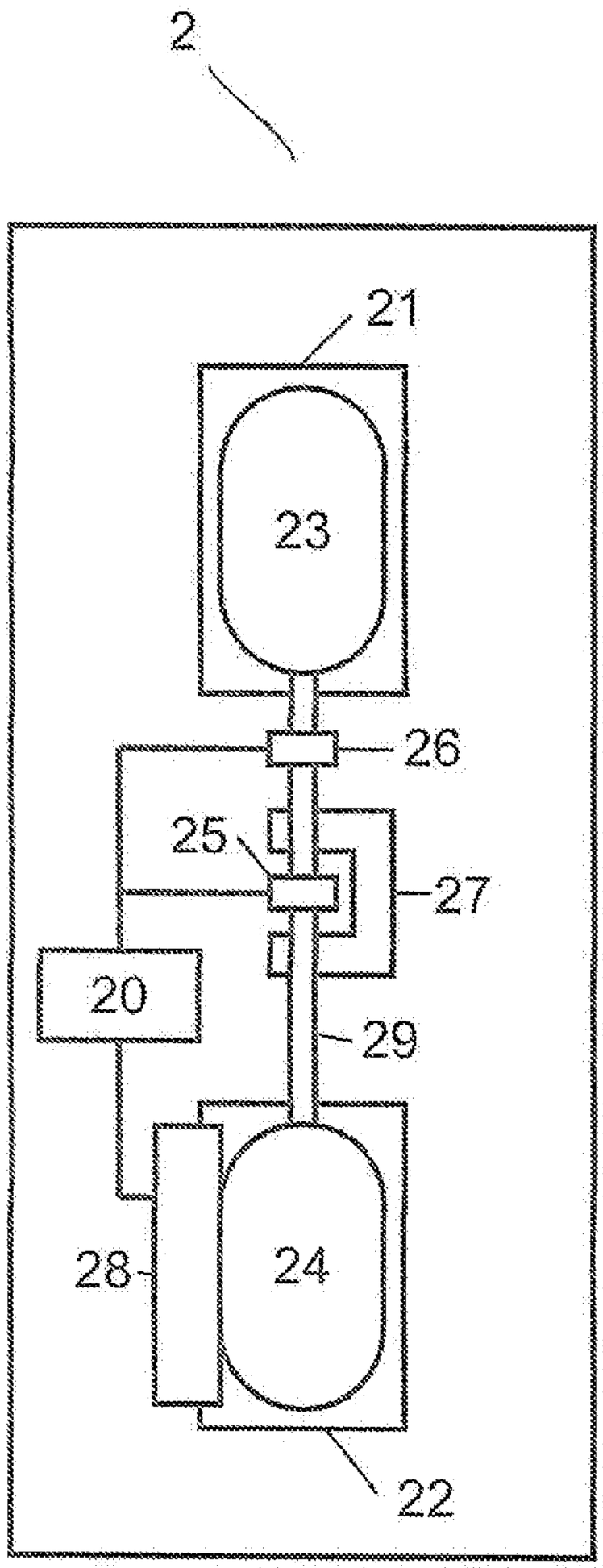


Fig. 5

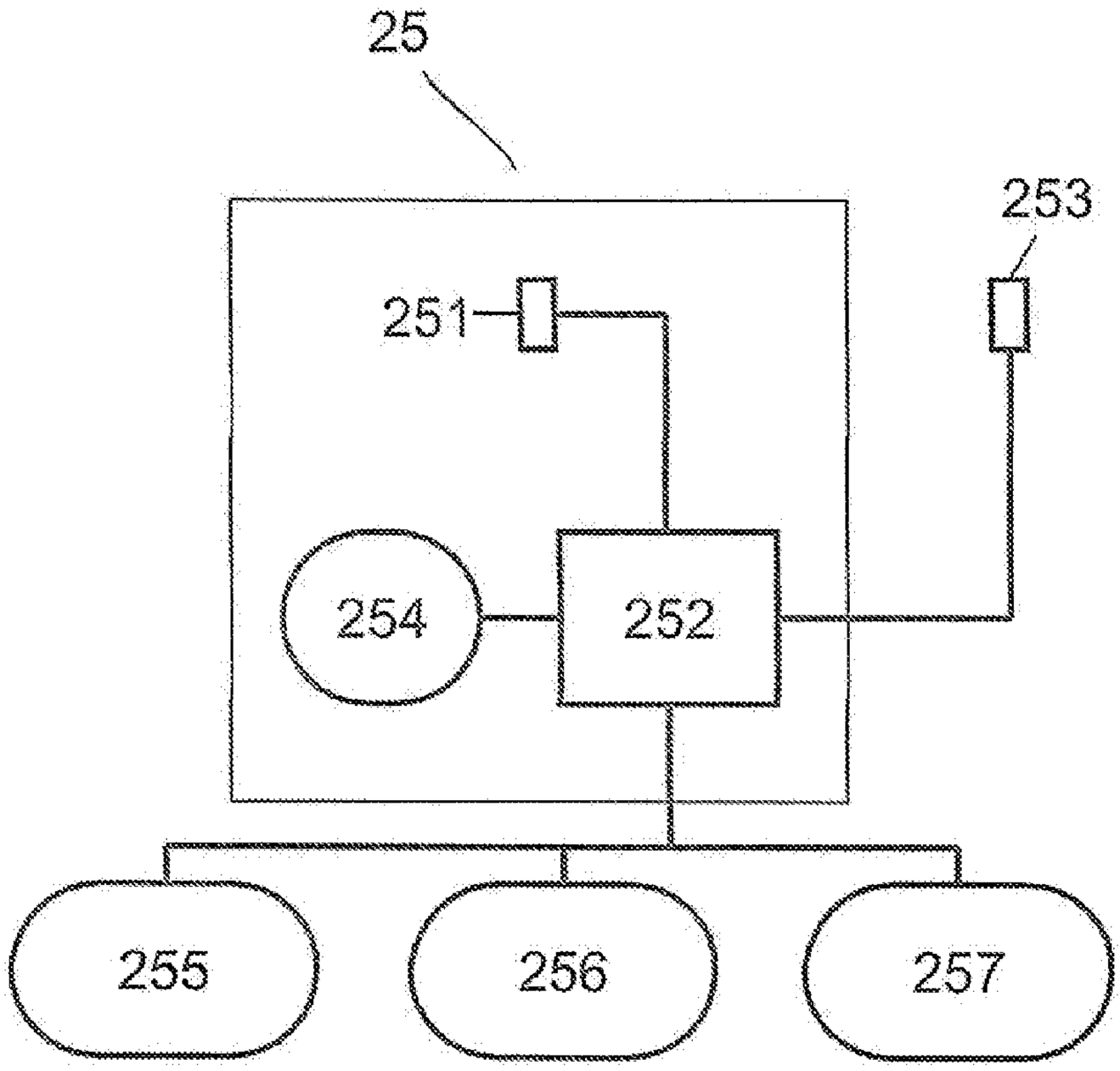


Fig. 6

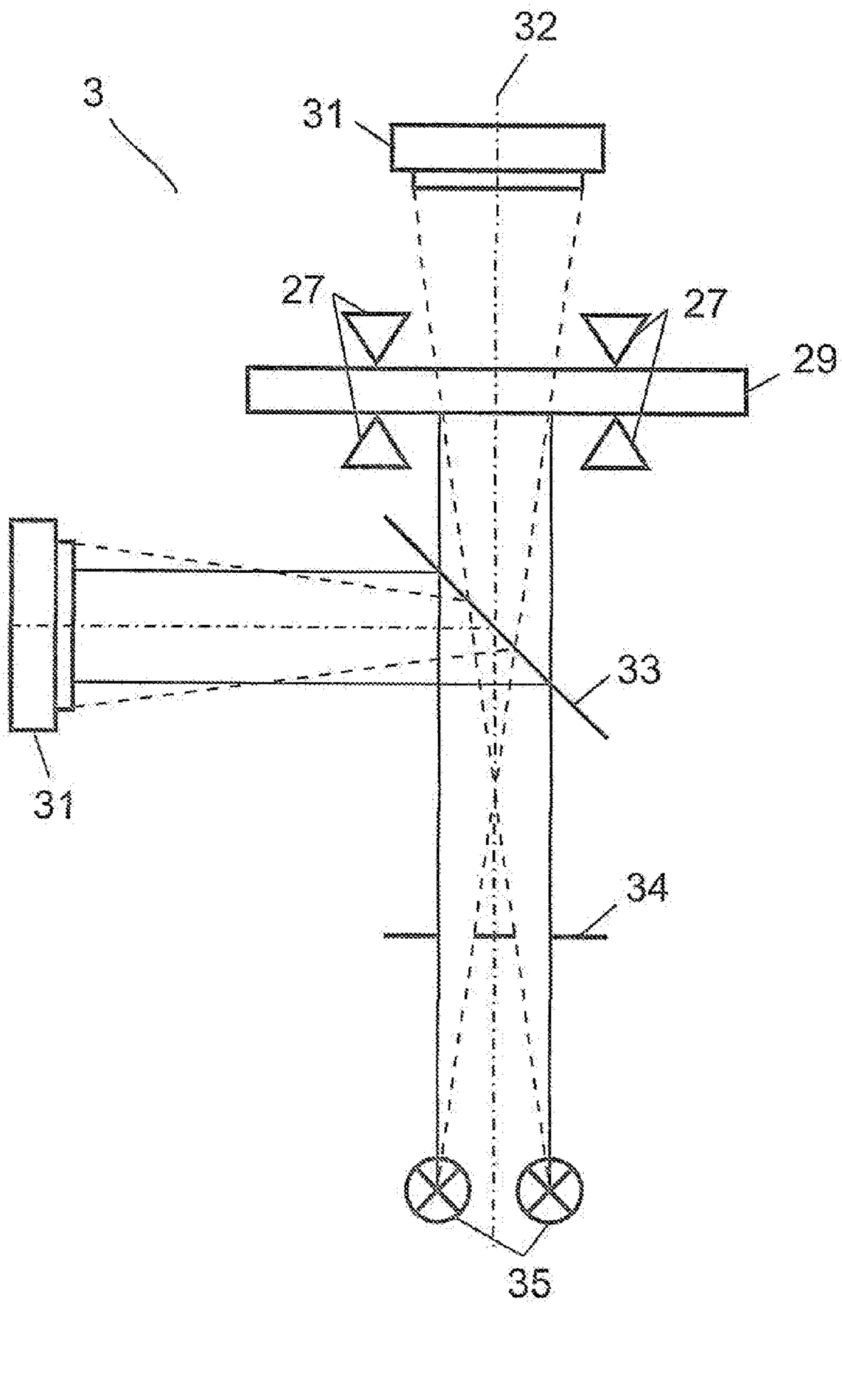


Fig. 7