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MEASURING BLOOD PRESSURE, AND
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Tanishima, Tokyo (JP)(21) Appl. No.: **14/927,909**(22) Filed: **Oct. 30, 2015**(30) **Foreign Application Priority Data**

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(57) **ABSTRACT**

A measuring device includes a measuring part that performs an invasive blood pressure measurement using a transducer and detects that a blood pressure measured by the invasive blood pressure measurement becomes a predetermined abnormal state during the invasive blood pressure measurement, a detecting part that detects whether or not a zero-point calibration of the transducer is being carried out, and a notification control part that controls whether or not to output an alarm based on a detection state of the detecting part when the blood pressure becomes the predetermined abnormal state.

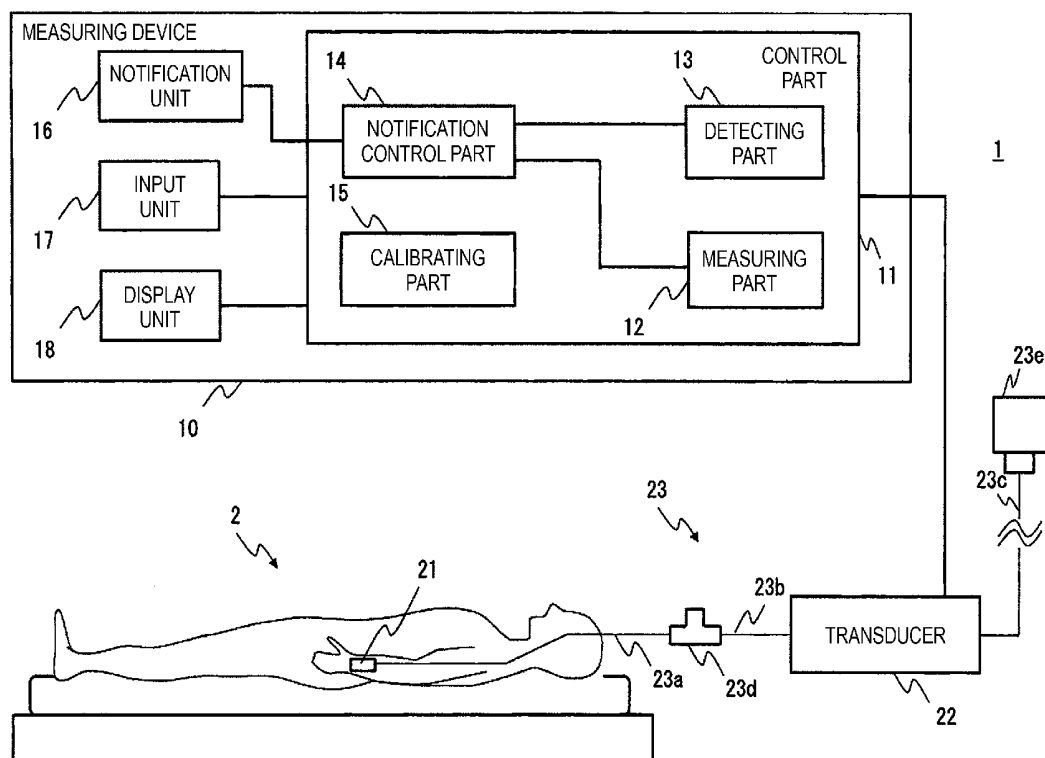


FIG. 1

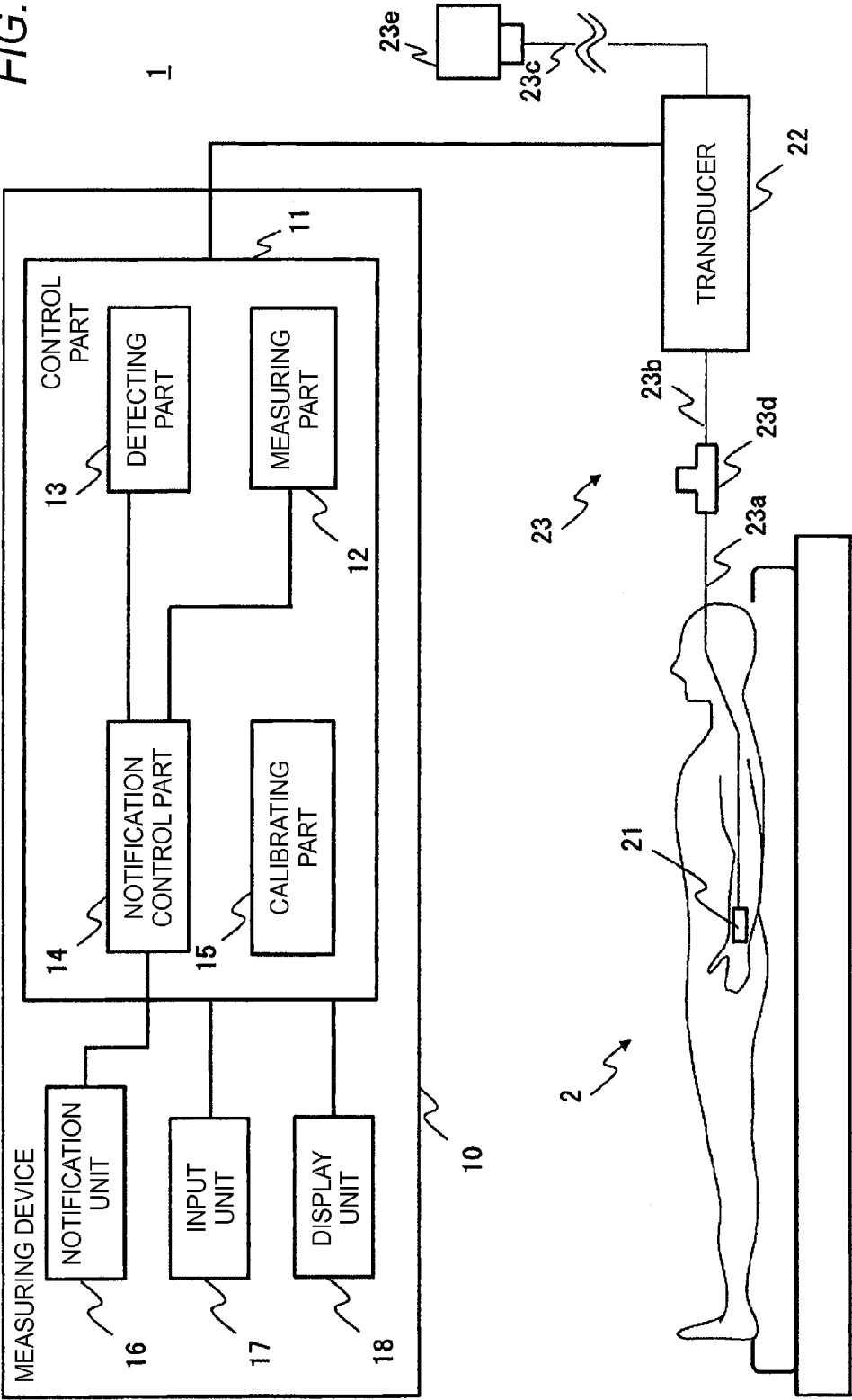


FIG. 2

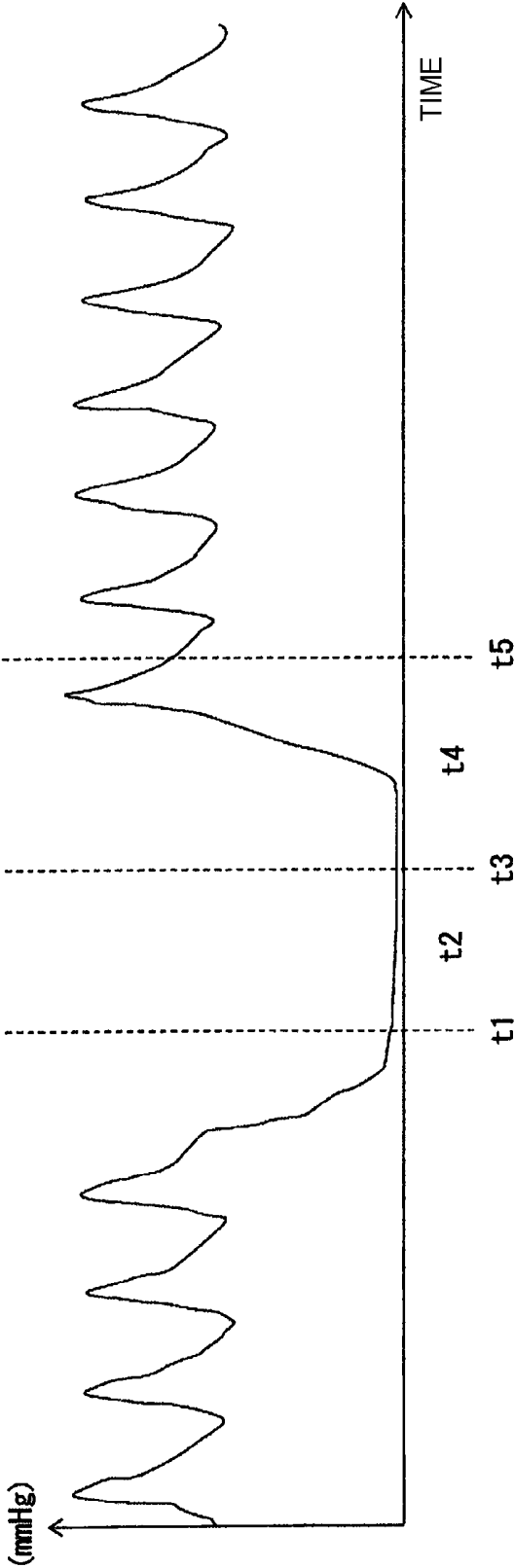


FIG. 3

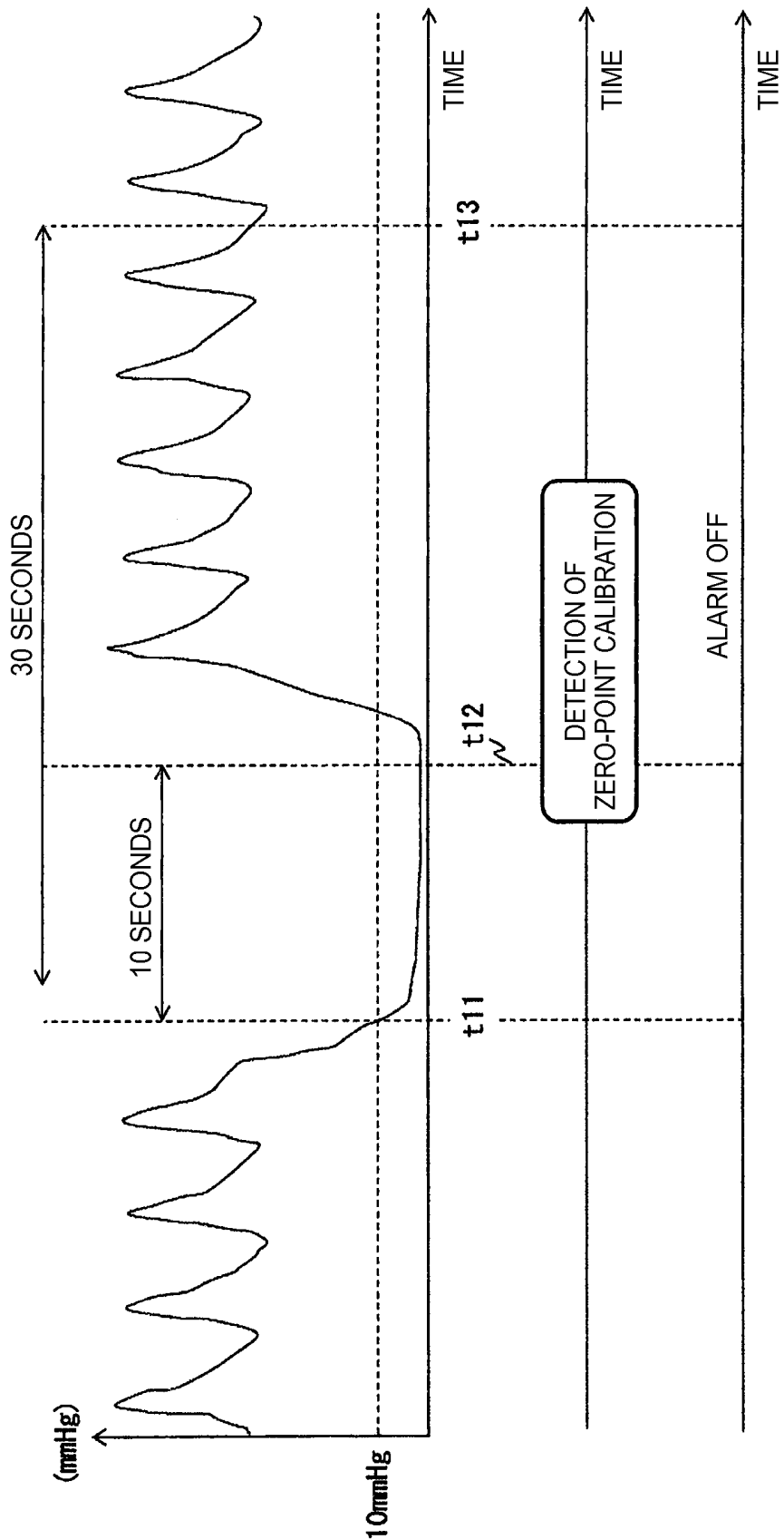


FIG. 4

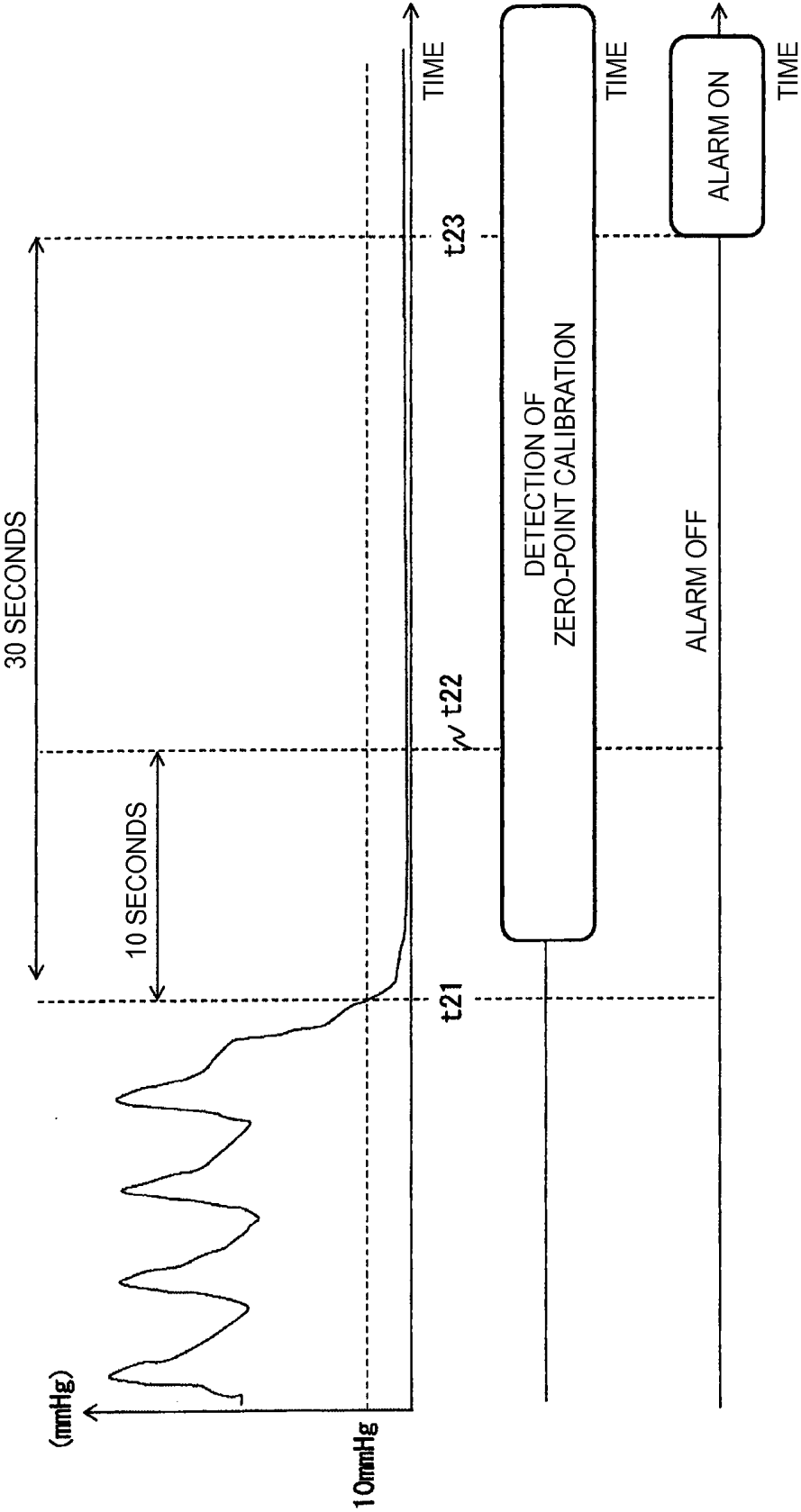
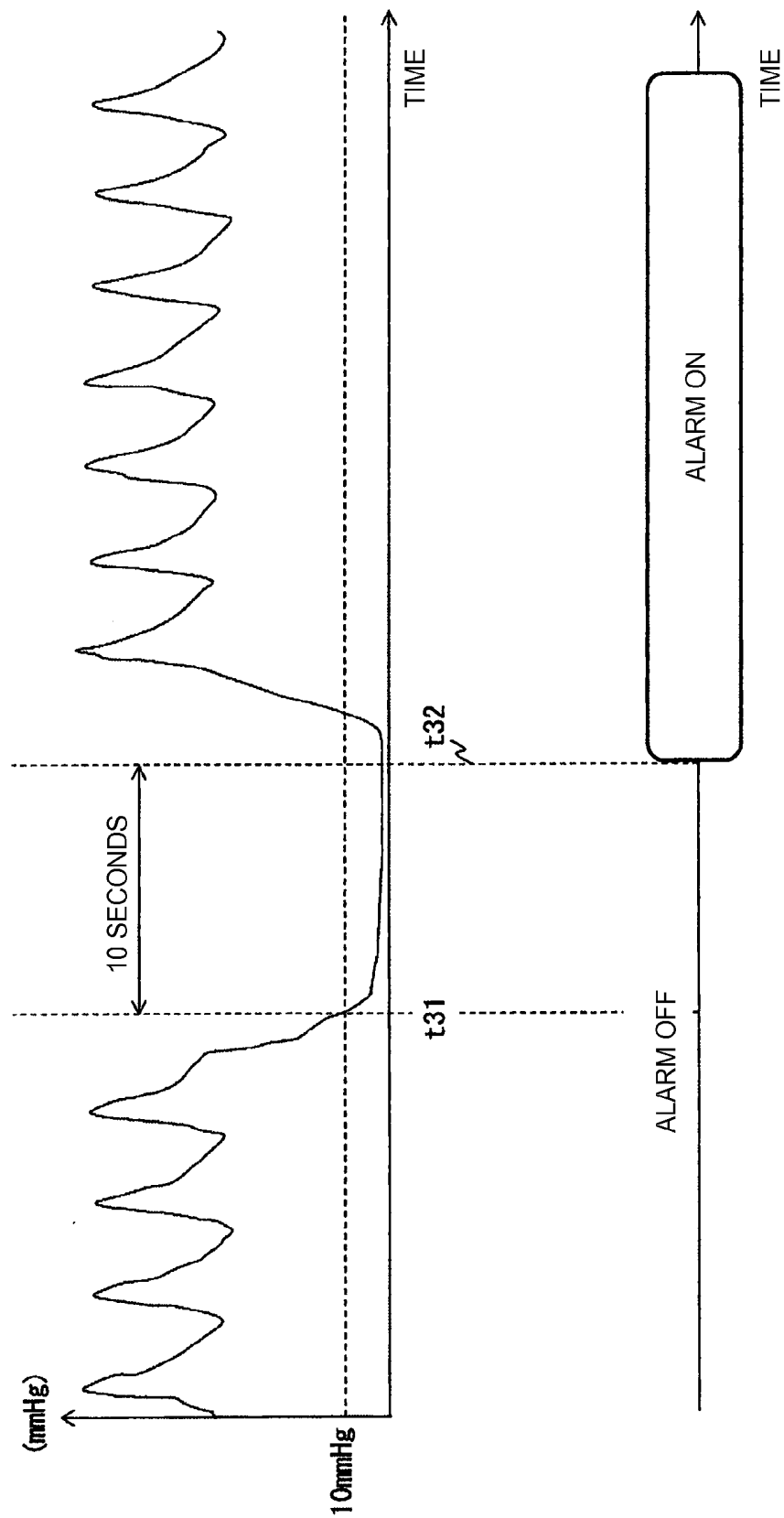


FIG. 5



MEASURING DEVICE, METHOD OF MEASURING BLOOD PRESSURE, AND PROGRAM

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is based on Japanese Patent Applications No. 2014-227656 filed on Nov. 10, 2014, the contents of which are incorporated herein by reference.

BACKGROUND

[0002] The present invention relates to a measuring device, a method of measuring a blood pressure and a program.

[0003] An invasive blood pressure measuring method is known in which a catheter or the like is inserted in a blood vessel of a subject so that a blood vessel varied from moment to moment is continuously measured (e.g., see JP-A-2013-517863). A pressure generated inside the blood vessel is converted to an electrical signal by a transducer connected to the catheter. Such a blood pressure manometer displays a blood pressure value or blood pressure waveform, which corresponds to an electrical signal converted by the transducer, to medical personnel or the like.

[0004] In the invasive blood pressure measurement, a processing referred to as a zero-point calibration for defining a measurement reference value is necessary. The zero-point calibration is carried out by arranging the transducer at a reference point and then defining, as the measurement reference value (e.g., 0 mmHg), an electrical signal corresponding to a blood pressure value when a pressure applied on the transducer is set to zero (the catheter is exposed to the atmosphere).

[0005] And now, when the invasive blood pressure measurement is performed, outputting of an alarm for notifying separation of the catheter attached to a patient is recommended. Medical personnel can instantly recognize separation of the catheter by referring to the alarm.

[0006] As described above, in such a blood pressure measuring system, a function of detecting separation of the catheter and then outputting an alarm are required.

[0007] This function is configured so that the alarm is outputted after a predetermined period of time (e.g., about 10 seconds) passes since a predetermined abnormal state (for example, a state where there is no detected pulse and an average blood pressure is 10 mmHg or less) has been caused.

[0008] However, when medical personnel carry out the zero-point calibration, this situation is likely to be decided as the abnormal state as described above. In this case, the alarm is outputted every time the zero-point calibration is carried out. Namely, there is a problem in that useless ringing of alarm is increased.

[0009] The problem is illustrated as in FIG. 5. FIG. 5 is a view showing a blood pressure fluctuation and an alarming operation when the zero-point calibration is carried out during a blood pressure measurement. Even while medical personnel carry out the zero-point calibration, an alarm is rung after a blood pressure drop (t31) has been detected (t32). Namely, useless ringing of alarm is occurred.

[0010] Accordingly, the present invention has been made keeping in mind the above problems, and a main object thereof is to provide a measuring device, a method of mea-

suring a blood pressure and a program, which can output a proper alarm even if a zero-point calibration is being carried out.

SUMMARY

[0011] According to an aspect of the present invention, a measuring device includes a measuring part that performs an invasive blood pressure measurement and detects that a blood pressure measured by the invasive blood pressure measurement becomes a predetermined abnormal state during the invasive blood pressure measurement, a detecting part that detects whether or not a zero-point calibration of the transducer used is being carried out, and a notification control part that controls whether or not to output an alarm based on a detection state of the detecting part when the blood pressure becomes the predetermined abnormal state.

[0012] The detecting part detects whether or not the zero-point calibration is being carried out. Also, the measuring part measures a blood pressure value and detects a predetermined abnormal state of the blood pressure. The notification control part controls ringing of alarm based on both of a carrying-out situation of the zero-point calibration and a state of the blood pressure. Thus, it is possible to avoid a situation where an alarm is rung during the zero-point calibration (in other words, useless ringing of alarm is occurred).

[0013] The present invention can provide a measuring device, a method of measuring a blood pressure and a program, which can output a proper alarm even if a zero-point calibration is being carried out.

BRIEF DESCRIPTION OF DRAWINGS

[0014] FIG. 1 is a block diagram showing configurations of a blood pressure measuring system 1 according to an embodiment 1.

[0015] FIG. 2 is a conceptual view showing a method of detecting a zero-point calibration by a detecting part 13 according to the embodiment 1.

[0016] FIG. 3 is a conceptual view showing a ringing control of alarm by a notification control part 14 according to the embodiment 1.

[0017] FIG. 4 is a conceptual view showing a sounding control of alarm by the notification control part 14 according to the embodiment 1.

[0018] FIG. 5 is a conceptual view showing an aspect of alarm rung in a typical measuring device.

DETAILED DESCRIPTION OF EMBODIMENTS

Embodiment 1

[0019] Embodiments of the present invention will be now described with reference to the accompanying drawings. FIG. 1 is a block diagram showing configurations of a blood pressure measuring system 1 according to the present embodiment. The blood pressure measuring system 1 is configured to invasively measure a blood pressure value of a subject 2. The blood pressure measuring system 1 has a measuring device 10. The measuring device 10 is preferable if the device can invasively measure a blood pressure, and for example, corresponds to a patient monitor, defibrillator or the like. It will be apparent that the measuring device 10 may have configurations capable of performing various measurements (such as

body temperature measurement, SpO₂, electrocardiogram, and breath curve), in addition to the invasive blood pressure measurement.

[0020] A shown example is a case of measuring an artery pressure, in which a catheter (artery needle) **21** is inserted in a radial artery of the subject **2**. A transducer **22** is fixed at a height of a heart of the subject **2** (i.e., a height of a location corresponding to a half of a chest thickness). The catheter **21** and the transducer **22** are connected to a monitoring line **23**.

[0021] The monitoring line **23** includes a first tube **23a**, a second tube **23b**, a third tube **23c**, a three-way stopcock **23d** and a fluid bottle **23e**. The first tube **23a** connects the catheter **21** with the three-way stopcock **23d**. The second tube **23b** connects the transducer **22** with the three-way stopcock **23d**. The three-way stopcock **23d** connects the first tube **23a** with the second tube **23b** to block out the atmosphere during measuring of a blood pressure. Also, the three-way stopcock **23d** is plugged to expose the transducer **22** to the atmosphere during being carried out of a zero-point calibration. The third tube **23c** connects the fluid bottle **23e** with the transducer **22**. The fluid bottle **23e** contains a heparin-containing saline solution.

[0022] The transducer **22** is a transducer used to invasively measure a blood pressure. The transducer **22** outputs an electrical signal corresponding to a pressure in a blood vessel of the subject **2** transmitted thereto through the heparin-containing saline solution. The measuring device **10** displays a blood pressure value or blood pressure waveform, which corresponds to the electrical signal, to a user such as medical personnel.

[0023] The measuring device **10** has a control unit **11**, a notification unit **16**, an input unit **17** and a display unit **18**. The control unit **11** includes a measuring part **12**, a detecting part **13**, a notification control part **14** and a calibrating part **15**. Also, the measuring device **10** appropriately has a secondary memory device and the like, not shown.

[0024] The notification unit **16** is intended to output a voice guidance or alarm and for example is constituted of a speaker, a speaker-peripheral circuit and the like. Alternatively, the notification unit **16** is not limited to outputting a sound, but may be configured to visually notify a warning, for example, as in an indicator. The output processing of the notification unit **16** is controlled by the notification control unit **14**, as described below. The input unit **17** is an interface for receiving a data input from medical personnel.

[0025] For example, the input unit **17** is buttons, knobs, switches and the like provided on a housing of the measuring device **10**. Also, the input unit **17** may be configured to be integrated with a display device (liquid crystal display) as in a touch panel. The input unit **17** includes button for a zero-point calibration and buttons for an all-zero processing as described below.

[0026] The display unit **18** includes a display device and a peripheral circuit (or software) for displaying various measurement values or display messages of the measuring device **10**. The display unit **18** may be a liquid crystal display or an indicator provided on the housing of the measuring device **10** and also may be a display device removably provided on the measuring device **10**.

[0027] Next, operations of each of processing parts in the control unit **11** will be described. The control unit **11** is intended to control the measuring device **10** and is configured to appropriately read out and execute a program from a memory unit (secondary memory device) not shown. For

example, the control unit **11** performs a displaying control during being carried out of a zero-point calibration.

[0028] The calibrating part **15** corrects a measurement reference value for a blood pressure value to be measured by the measuring device **10**. At a point of time, such as starting of a blood pressure measurement, a zero-point calibration of the measuring device **10** is performed.

[0029] Specifically, the three-way stopcock **23d** is switched to an exposed state to the atmosphere, so that a pressure applied on the transducer **22** becomes zero. The calibrating part **15** performs an internal calibration so that an electrical signal inputted to the measuring device **10** in such a state is set to as a reference value (e.g., 0 mmHg).

[0030] The measuring part **12** performs an invasive blood pressure measurement. Namely, the measuring part **12** calculates a blood pressure value or blood pressure waveform of the subject **2** on the basis of data obtained by digitally converting the electrical signal outputted from the transducer **22**. A method for calculating the blood pressure value or blood pressure waveform is preferably identical to a technique in a typical invasive blood pressure measurement. The calculated blood pressure value or blood pressure waveform is displayed on the display unit **18**.

[0031] Also, the measuring part **12** detects that the subject **2** is in a predetermined abnormal state on the basis of the calculated blood pressure value or blood pressure waveform. Herein, the predetermined abnormal state is a state where separation of the catheter **21** from the patient is occurred or the like. For example, the predetermined abnormal state is a case where a state in which there is no pulse and an average blood pressure value is 10 mmHg or less is continued during a predetermined period of time or more (e.g., about 10 seconds).

[0032] The detecting part **13** detects whether or not the zero-point calibration is being carried out. For example, the detecting part **13** decides whether or not the zero-point calibration is being carried out in accordance with the following technique.

[0033] (1) Pushing of a “Zero-Point Calibration/All-Zero” Button

[0034] The detecting part **13** monitors an input interface (button, knob, or switch) associated with the zero-point calibration, thereby deciding that the zero-point calibration is being carried out when an operation thereof indicating that the zero-point calibration is carried out is performed.

[0035] (2) Executing of a Zero-Point Calibration Processing

[0036] The detecting part **13** monitors operation of the calibrating part **15**, thereby detecting that the zero-point calibration is being carried out (e.g., a software for the zero-point calibration is being executed).

[0037] (3) Displaying of a Message Related to the Zero-Point Calibration

[0038] The detecting part **13** monitors a displaying instruction, which is sent from the calibrating part **15** to the display unit **18** and is related to that the zero-point calibration is being carried out, or a message displaying processing in the display unit **18** related to that the zero-point calibration is being carried out. Further, the detecting part **13** decides that the zero-point calibration is being carried out when a message indicating that the zero-point calibration is being carried out is displayed. Also, the detecting part **13** decides that the zero-point calibration is being carried out when a dedicated screen for the zero-point calibration is displayed on the dis-

play unit 18. In addition, the detecting part 14 decides that the zero-point calibration has been ended when an ending message of the zero-point calibration is displayed.

[0039] (4) Detection of an All-Zero Operation

[0040] A detecting method related to the all-zero is used in a case where a plurality of catheters 21 are used to perform an invasive blood pressure measurement at a plurality of locations. The detecting part 13 decides that the zero-point calibration is being carried out when the all-zero operation (operation of being carried out the zero-point calibration at the plurality of locations) by a software is detected.

[0041] An operation image of the detecting part 13 is newly described with reference to FIG. 2. FIG. 2 is an example of a blood pressure waveform representing fluctuation of blood pressure values measured by the invasive blood pressure measurement. At time t1, the detecting part 13 detects that the zero-point calibration is being carried out when a button for the “zero-point calibration” or an interface for the “all-zero operation” is operated. Also, at a time t2, the detecting part 13 detects that the zero-point calibration is being carried out when a message related to that the zero-point calibration is being carried out is displayed from the display unit 18.

[0042] It is assumed that the zero-point calibration is ended at a time t3. At a time t4, the detecting part 13 decides that the zero-point calibration has been ended when a message (“zero-point calibration completion”, “change in zero value”, “outside of zero value range” or the like) related to ending of the zero-point calibration is displayed. Also, at a time t5, the detecting part 13 decides that the device has returned to a normal measurement when displaying the message related to ending of the zero-point calibration is ended.

[0043] The foregoing is the method of detecting that the zero-point calibration is being carried out by the detecting part 13. Alternatively, the detecting part 13 may employ any other detecting techniques so long as it is possible to detect that the zero-point calibration is being carried out. The detecting part 13 notifies whether or not the zero-point calibration is being carried out to the notification control part 14 in real time.

[0044] Again referring to FIG. 1, the notification control part 14 controls outputting of alarm by the notification unit 16 on the basis of a detection state of the zero-point calibration by the detecting part 13 and a detection state of the predetermined abnormal state by the measuring part 12. Next, a control image will be described with reference to FIGS. 3 and 4.

[0045] FIG. 3 is a conceptual view showing a first operation example of the notification control part 14. The measuring part 12 continuously measures a blood pressure value or blood pressure waveform. The measuring part 12 detects that an average blood pressure value becomes 10 mmHg or less and there is no detected pulse (t11). Also, the measuring part 12 detects that a predetermined period of time (e.g., 10 seconds) passes since there has been no longer a pulse and the average blood pressure value has become 10 mmHg or less (a predetermined value or less). At the approximately same time, the detecting part 12 detects that the zero-point calibration is being carried out in accordance with the foregoing technique.

[0046] At a time t12, the notification control part 14 decides that the zero-point calibration is being carried out, although the state where there is no pulse and the average blood pressure value is 10 mmHg or less is continued during a predetermined period of time or more. Because the zero-point calibration is being carried out, the notification control part 14

controls alarm related to separation of the catheter not to be rung at the time t12 (alarm OFF).

[0047] Alternatively, the notification control part 14 may control the alarm in consideration of the zero-point calibration at the timing (t11) at which there is no longer a pulse and the average blood pressure value becomes 10 mmHg or less. However, a case where a blood pressure value is temporarily dropped but the blood pressure waveform is raised due to operation of the circulator of the subject 2 has to be considered. Thus, outputting of the alarm is preferably controlled after a predetermined period of time passes since the average blood pressure value has become the predetermined value or less as shown in FIG. 3 (t12).

[0048] The notification control part 14 again controls the alarm at a timing (t13) after a predetermined period of time (after 30 seconds in the present example) from a predetermined timing. At the time t13, the measuring part 12 detects that the average blood pressure value is 10 mmHg or more or there is a pulse. Namely, the measuring part 12 detects that the blood pressure returns to a typical blood pressure state. Accordingly, at the time t13, the notification control part 14 decides that the current state is a normal state and thus controls the alarm not to be rung (alarm OFF).

[0049] Meanwhile, the predetermined timing (timing at which the 30-second counting is started) may be a timing of t1 to t5 in FIG. 2 as described above, t11 in FIG. 3 or the like. Namely, the predetermined timing corresponds for example to the followings.

[0050] (A) An operating timing of interfaces for the “zero-point calibration” or the “all-zero”.

[0051] (B) Starting displaying a message related to that the zero-point calibration is being carried out.

[0052] (C) Ending of the zero-point calibration,

[0053] (D) Starting displaying a message related to ending of the zero-point calibration.

[0054] (E) Ending displaying the message related to ending of the zero-point calibration.

[0055] (F) Initiating of the predetermined abnormal state (t11 in FIG. 3).

[0056] The 30 seconds means a period of time sufficient to end the zero-point calibration, and thus 25 seconds or the like may be employed. In other words, the operations as described above are as follows. The measuring part 12 decides whether or not the average blood pressure value becomes again the predetermined abnormal state after suppressing the alarm by the zero-point calibration (t13 in FIGS. 3 and t2 in FIG. 4 as described below). The notification control part 14 controls an alarm not to be rung when the average blood pressure value is decided as being in a normal state. Alternatively, the notification control part 14 may control the alarm to be rung if the average blood pressure value is decided as becoming again the predetermined abnormal state.

[0057] FIG. 4 is a conceptual view showing a second operation example of the notification control part 14. The measuring part 12 detects that an average blood pressure value becomes 10 mmHg or less and there is no detected pulse (t21). Also, the measuring part 12 detects that a state where there is no pulse and the average blood pressure value is 10 mmHg or less is continued during a predetermined period of time (e.g., 10 seconds) (t22). However, at the time t22, the notification control part 14 controls an alarm related to separation of the catheter not to be rung, because the zero-point calibration is being carried out (alarm OFF).

[0058] The notification control part **14** also controls the alarm at a timing (t23) after 30 seconds from the predetermined timing. The detecting part **13** notifies to the notification control part **14** that the zero-point calibration is still being carried out. Also, the measuring part **12** notifies to the notification control part **14** that the average blood pressure value is still 10 mmHg or less. Because the average blood pressure value is still lower, the notification control part **14** controls the alarm to be rung even if it is decided that the zero-point calibration is being carried out (t23, alarm ON). In this way, the notification control part **14** controls the alarm to be outputted when the average blood pressure value is still lower even if some time passes after suppressing the alarm.

[0059] The foregoing is the detailed operation of the notification control part **14**. In this way, the notification control part **14** controls ringing of alarm depending on whether or not the zero-point calibration is being carried out. Meanwhile, if not shown, the notification control part **14** rings an alarm about a typical separation of the catheter if the average blood pressure value becomes 10 mmHg or less while detection of the zero-point calibration is not carried out.

[0060] Also, although a threshold value of the average blood pressure value is described as 10 mmHg in the foregoing description, the present invention may employ any other values if the values have a gap from average blood pressure values of healthy people.

[0061] Next, the effects of the measuring device **10** according to the present embodiment will be described. As described above, the detecting part **13** detects whether or not the zero-point calibration is being carried out. Also, the measuring part **12** measures a blood pressure value and detects the predetermined abnormal state. The notification control part **14** controls ringing of alarm based on both of a carrying-out situation of the zero-point calibration and a state of the blood pressure. Thus, it is possible to avoid a situation where an alarm is rung during the zero-point calibration (in other words, useless ringing of alarm is occurred).

[0062] Also, the notification control part **14** rings alarm if a state where the zero-point calibration is being carried out is continued during a predetermined period of time (i.e., t23 in FIG. 4) (alarm ON). Thus, medical personnel can recognize separation of the catheter **21** during carrying out of the zero-point calibration or forgetting returning the three-way stopcock **23**.

[0063] In the foregoing, the invention achieved by the present inventors has been described in detail based on the embodiments, but it will be apparent that the present invention is not limited to the embodiments described above and various modifications thereof can be made without departing from the spirit thereof.

[0064] Meanwhile, some or all of the processing of the control unit **11** in the measuring device **10** may be embodied as computer programs which are operated in the measuring device **10**. For example, the measuring part **12** calculates a blood pressure value or blood pressure waveform using data digitalized by A/D-converting a blood pressure signal outputted from the transducer **22**.

[0065] Herein, the program can be stored using various types of non-transitory computer readable media and be supplied to a computer. The non-transitory computer readable media include various types of tangible storage media. Examples of non-transitory computer readable media include magnetic recording media (e.g., a flexible disk, a magnetic tape, a hard disk drive), magneto-optical recording media

(e.g., a magneto-optical disk), CD-ROM (Read Only Memory), CD-R, CD-R/W, semiconductor memories (e.g., mask ROM, PROM(Programmable ROM), EPROM(Erasable PROM), flash ROM, RAM(random access memory)). Also, the program may be supplied to the computer by various types of transitory computer readable media. Examples of transitory computer readable media include electrical signals, optical signals and electromagnetic waves. The transitory computer readable media can supply the program to the computer through a wire communication path, such as electric wires or optic fibers, or a wireless communication path.

What is claimed is:

1. A measuring device, comprising:

a measuring part that performs an invasive blood pressure measurement using a transducer and detects that a blood pressure measured by the invasive blood pressure measurement becomes a predetermined abnormal state during the invasive blood pressure measurement;

a detecting part that detects whether or not a zero-point calibration of the transducer is being carried out; and

a notification control part that controls whether or not to output an alarm based on a detection state of the detecting part when the blood pressure becomes the predetermined abnormal state.

2. The measuring device according to claim 1, wherein the measuring part detects, as the predetermined abnormal state, a state where, during the invasive blood pressure measurement, there is no detected pulse and an averaged blood pressure value is a predetermined value or less.

3. The measuring device according to claim 1, wherein the measuring part detects, as the predetermined abnormal state, case where a state in which, during the invasive blood pressure measurement, there is no detected pulse and an averaged blood pressure value is a predetermined value or less is continued during a predetermined period of time or more.

4. The measuring device according to claim 1, wherein the notification control part suppresses outputting an alarm if the blood pressure measured by the measuring part is in the predetermined abnormal state and the zero-point calibration is being carried out, and outputs an alarm if the blood pressure is still in the predetermined abnormal state after a predetermined period of time from a predetermined timing.

5. The measuring device according to claim 4, wherein the predetermined timing is any one of an operation timing of a interface for the zero-point calibration, a timing of starting displaying a message related to that the zero-point calibration is being carried out, an ending timing of the zero-point calibration, a timing of starting displaying a message related to ending of the zero-point calibration, and a timing of ending displaying of the message related to ending of the zero-point calibration.

6. The measuring device according to claim 1, wherein the notification control part suppresses outputting an alarm if the blood pressure measured by the measuring part is in the predetermined abnormal state and the zero-point calibration is being carried out, and thereafter outputs an alarm if the blood pressure measured by the measuring part is decided as becoming again the predetermined abnormal state.

7. A method of measuring a blood pressure, comprising:

performing an invasive blood pressure measurement using a transducer;

detecting that a blood pressure becomes a predetermined abnormal state during the invasive blood pressure measurement;

detecting whether or not a zero-point calibration of the transducer is being carried out; and

controlling whether or not to output an alarm based on a detection state of the zero-point calibration when the blood pressure becomes the predetermined abnormal state.

8. A non-transitory computer readable medium storing a program causing a computer to execute a process comprising: performing an invasive blood pressure measurement using a transducer;

detecting that a blood pressure becomes a predetermined abnormal state during the invasive blood pressure measurement;

detecting whether or not a zero-point calibration of the transducer is being carried out; and

controlling whether or not to output an alarm based on a detection state of the zero-point calibration when the blood pressure becomes the predetermined abnormal state.

9. The measuring device according to claim 1 further comprising a calibrating part that corrects a measurement reference value for a blood pressure value to be measured by the invasive blood pressure measurement.

10. The measuring device according to claim 2, wherein the predetermined value is 10 mmHg.

* * * * *

专利名称(译)	测量装置，测量血压的方法和程序		
公开(公告)号	US20160128584A1	公开(公告)日	2016-05-12
申请号	US14/927909	申请日	2015-10-30
[标]申请(专利权)人(译)	日本光电工业株式会社		
申请(专利权)人(译)	日本光电公司		
当前申请(专利权)人(译)	日本光电公司		
[标]发明人	KOYAMA YUKIO HARADA YOSHIHARU TANISHIMA MASAMI		
发明人	KOYAMA, YUKIO HARADA, YOSHIHARU TANISHIMA, MASAMI		
IPC分类号	A61B5/0215 A61B5/00		
CPC分类号	A61B5/02156 A61B5/7282 A61B5/742 A61B5/746 A61B5/0215 A61B5/7275		
优先权	2014227656 2014-11-10 JP		
外部链接	Espacenet USPTO		

摘要(译)

测量装置包括使用换能器执行有创血压测量的测量部分，并且在有创血压测量期间检测通过有创血压测量测量的血压变为预定的异常状态，检测部分检测是否有正在执行换能器的零点校准，以及当血压变为预定的异常状态时基于检测部分的检测状态控制是否输出警报的通知控制部分。

and detects that a blood pressure measured by the invasive blood pressure measurement becomes a predetermined abnormal state during the invasive blood pressure measure-