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(19) **United States**(12) **Patent Application Publication**
Okuda et al.(10) **Pub. No.: US 2012/0199239 A1**(43) **Pub. Date: Aug. 9, 2012**(54) **SYSTEM FOR ASSISTING MEDICINAL
LIQUID PREPARATION AND METHOD FOR
ASSISTING MEDICINAL LIQUID
PREPARATION****Publication Classification**(51) **Int. Cl.**
B65B 3/26

(2006.01)

(52) **U.S. Cl. 141/1; 141/83**(75) **Inventors:** **Akinobu Okuda**, Nara (JP); **Tohru Nakamura**, Osaka (JP); **Soichiro Fujioka**, Osaka (JP); **Osamu Mizuno**, Osaka (JP); **Akihiro Ohta**, Osaka (JP)(73) **Assignee:** **PANASONIC CORPORATION**,
Kadoma-shi, Osaka (JP)(21) **Appl. No.:** **13/501,404**(22) **PCT Filed:** **Oct. 6, 2010**(86) **PCT No.:** **PCT/JP2010/005979**§ 371 (c)(1),
(2), (4) Date:**Apr. 11, 2012**(30) **Foreign Application Priority Data**

Oct. 14, 2009 (JP) 2009-236932

(57) **ABSTRACT**

A medicinal liquid preparation assist system according to the present invention includes a medicine bottle weight measurement unit having a first weight measurement portion for measuring the total weight of medicine bottles placed on a medicine bottle mounting portion; an infusion bag weight measurement unit having a second weight measurement portion for measuring the weight of an infusion bag placed on an infusion bag mounting portion; a storage unit; a control unit for producing auditing information based on changes in weight measured by the medicine bottle weight measurement unit and the infusion bag weight measurement unit, and storing the produced auditing information in the storage unit; and an information presentation unit for displaying at least one of information about medicinal liquids to be injected into the infusion bag, the information being stored beforehand in the storage unit, and the auditing information stored in the storage unit by the control unit.

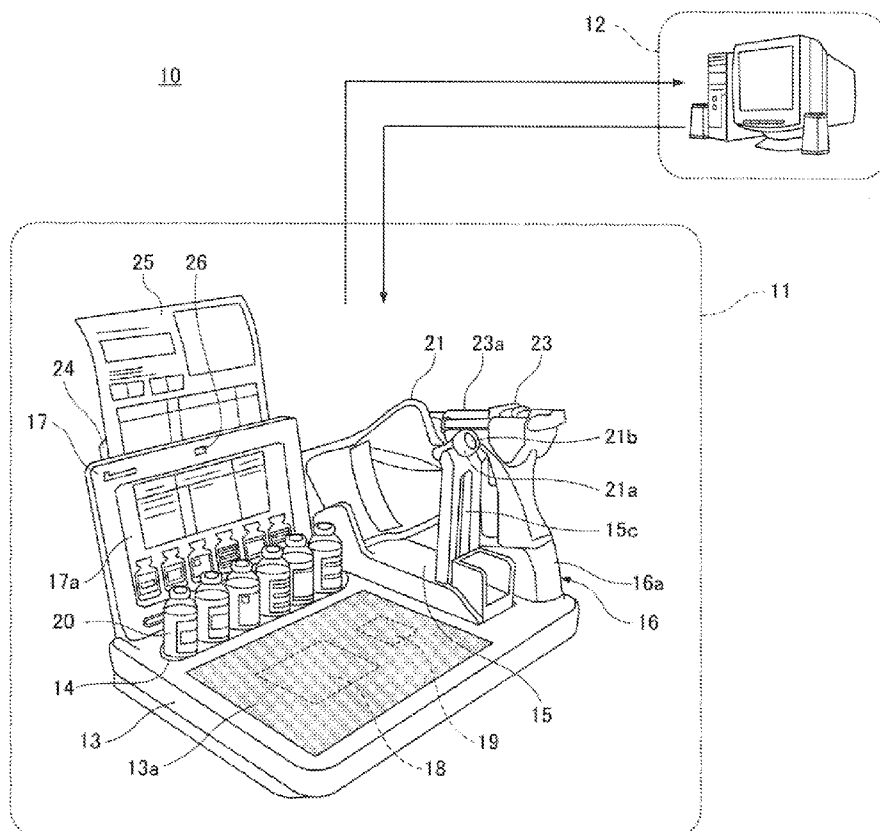


FIG. 1

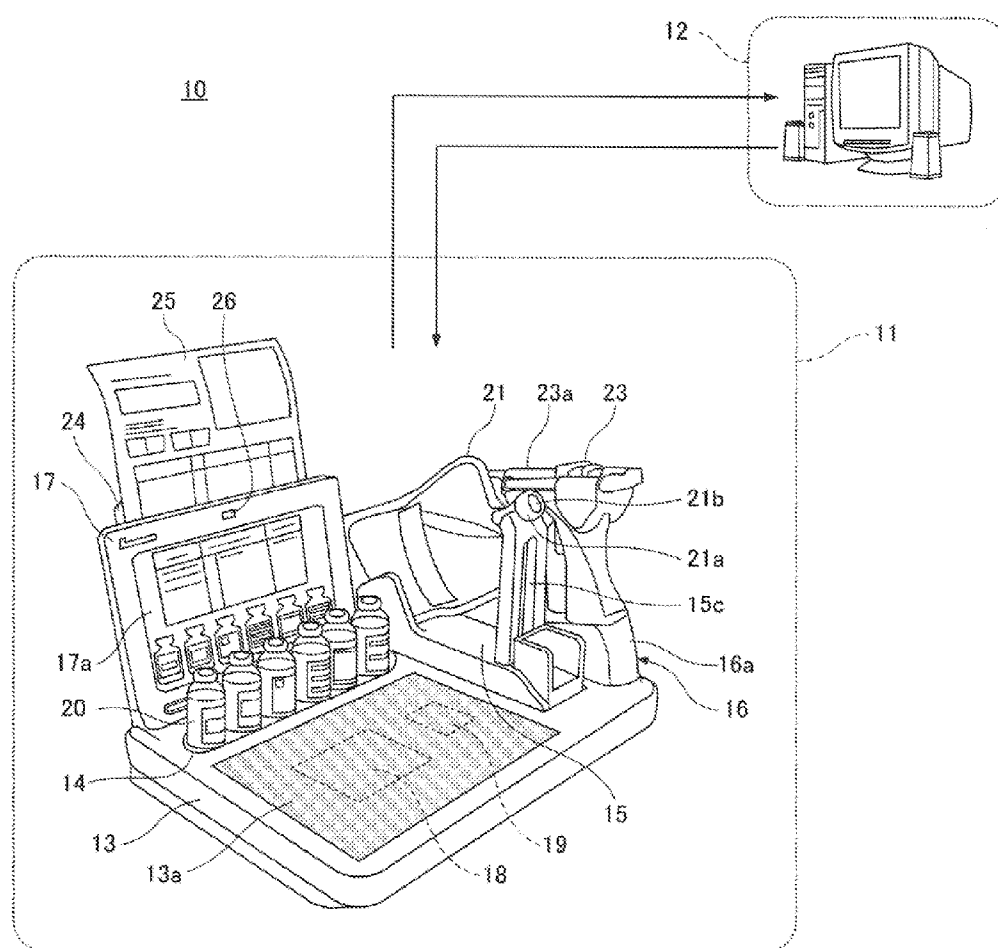
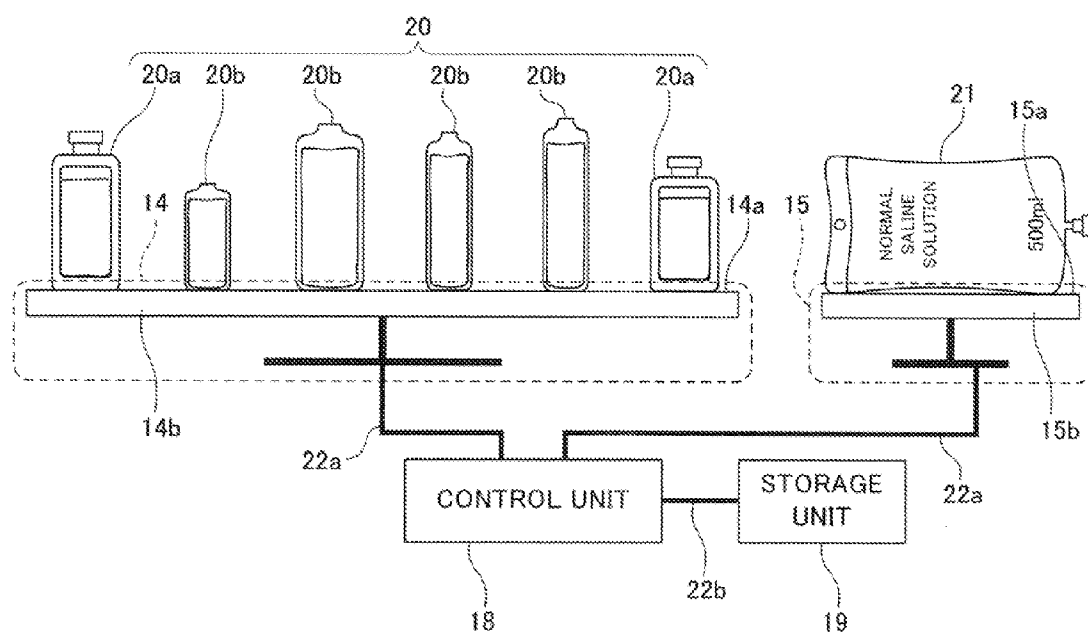


FIG. 2



ॐ
ॐ
ॐ

17a

17b

17c

17d

PREPARE

WITHDRAW

INJECT

AUDIT

END

SET THE MEDICINE BOTTLE AND INFUSION BAG ACCORDING TO DISPLAY CONTENT

17e

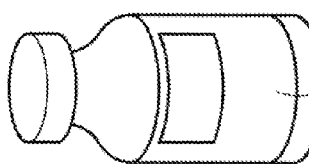
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HOSPITAL ROOM	300	NAME	O Δ □ ×	DATE OF BIRTH	A31-04-01 M40
DEPARTMENT	53 RESPIRATORY SURGERY	DOCTOR	◇ ◇ Δ Δ	DATE AND HOUR OF ISSUE	09.07.29 14:52
				DATE AND HOUR OF ADMINISTRATION	09.07.30 08:15

17f

20c

MEDICINAL LIQUID A
5mg

AMOUNT: 1V



MEDICINAL LIQUID B
5mg / mL

AMOUNT: 1A



MEDICINAL LIQUID C
5mg

AMOUNT: 1V



MEDICINAL LIQUID C
5mg

AMOUNT: 1V



MEDICINAL LIQUID C
5mg

AMOUNT: 1V



MEDICINAL LIQUID C
5mg

AMOUNT: 1V



20c

FIG. 4

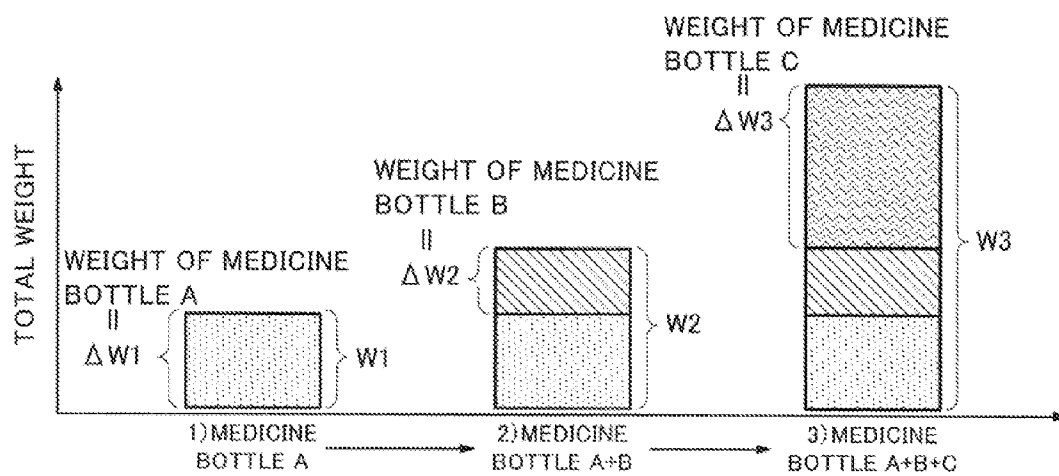


FIG. 5

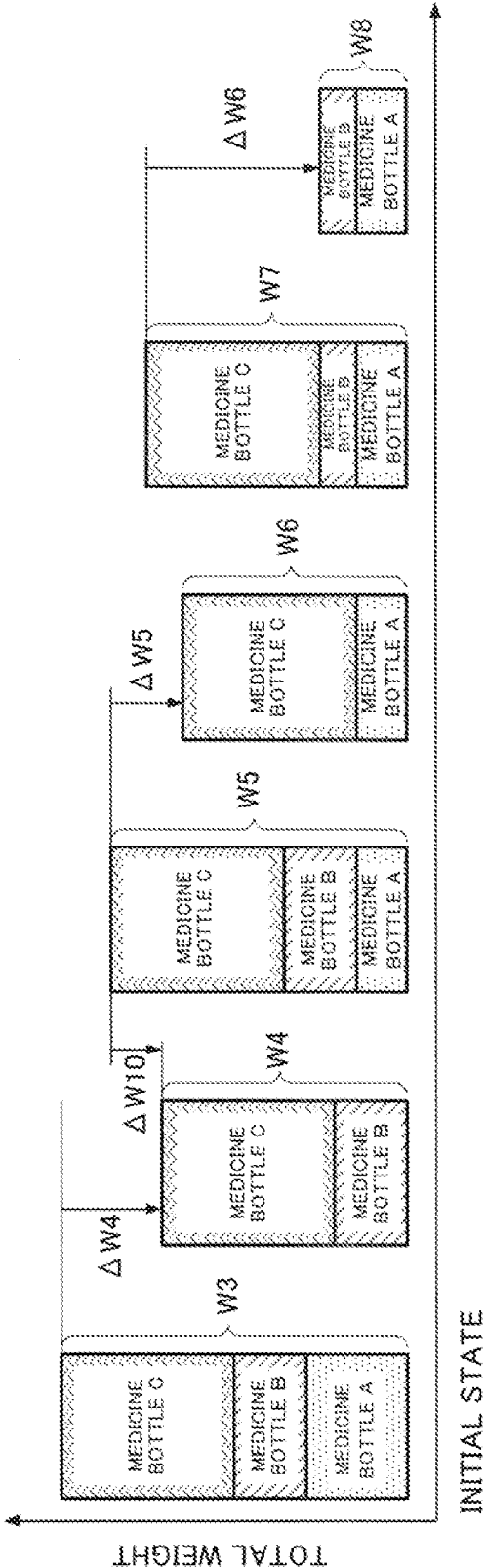


FIG. 6

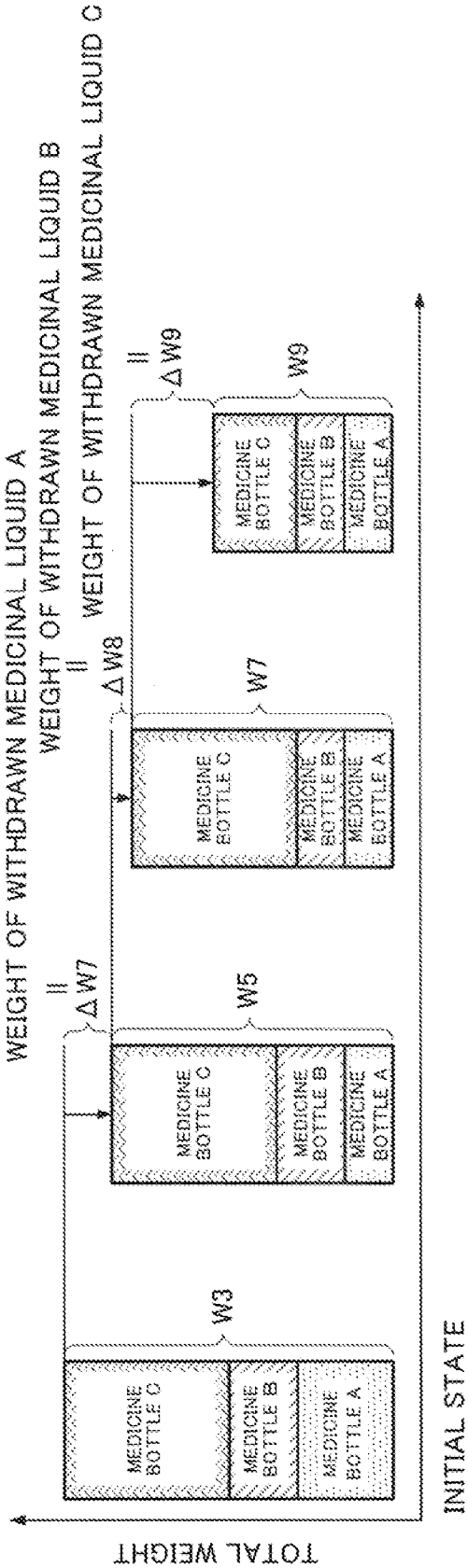


FIG. 7

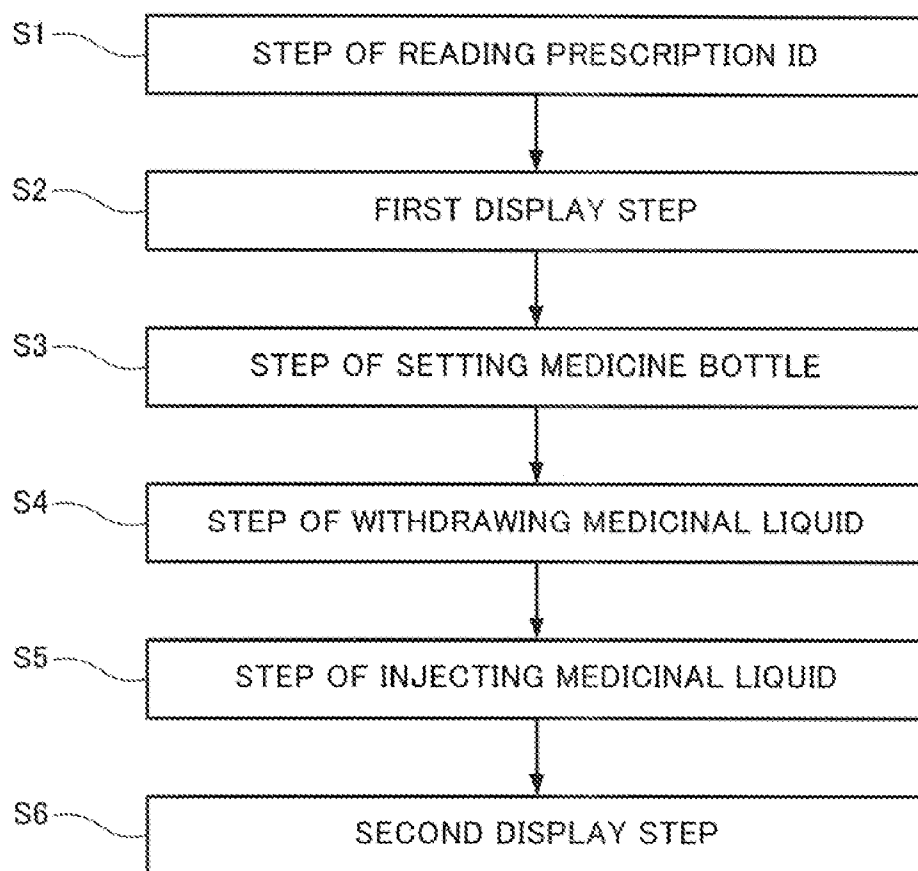


FIG. 8

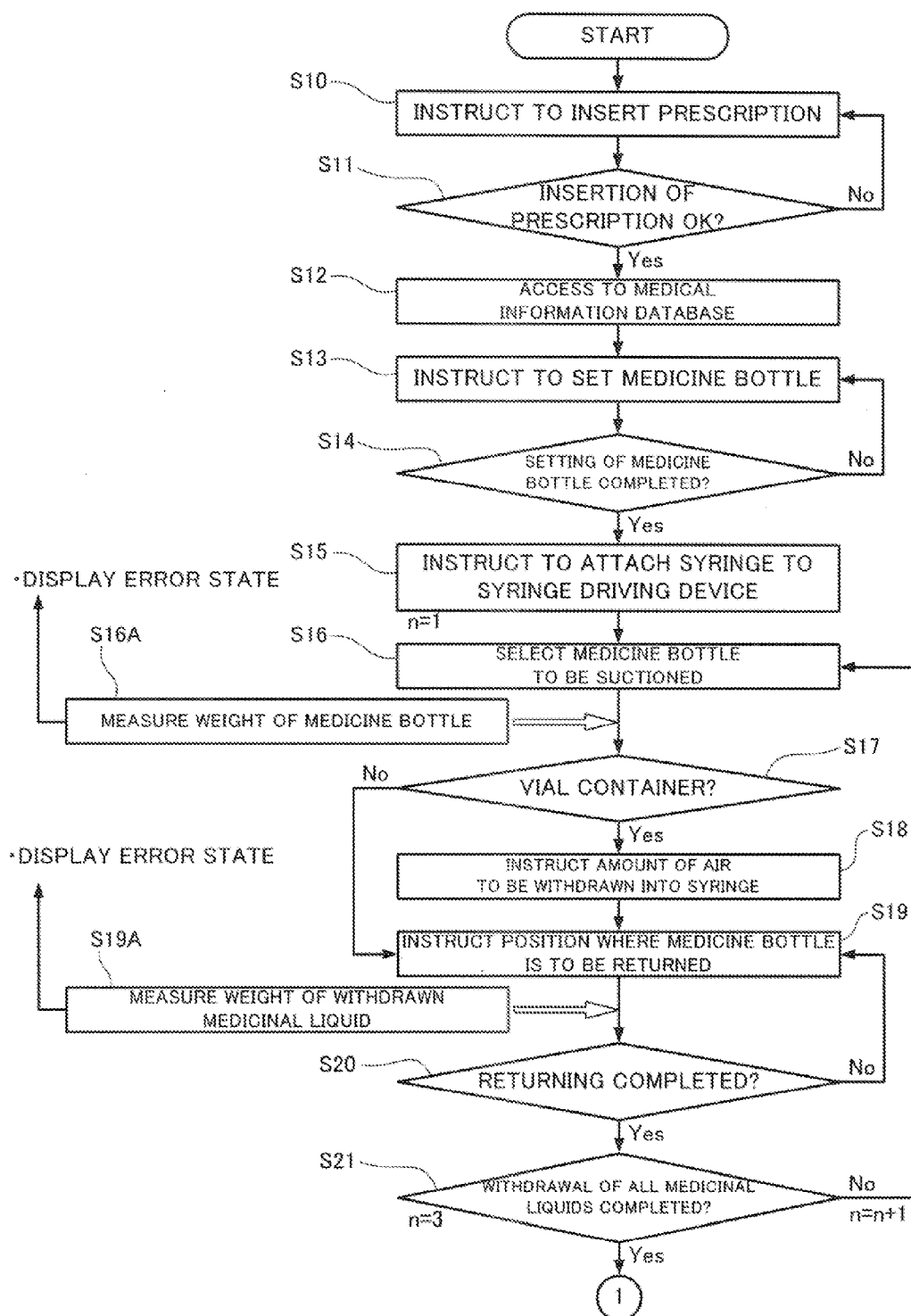


FIG. 9

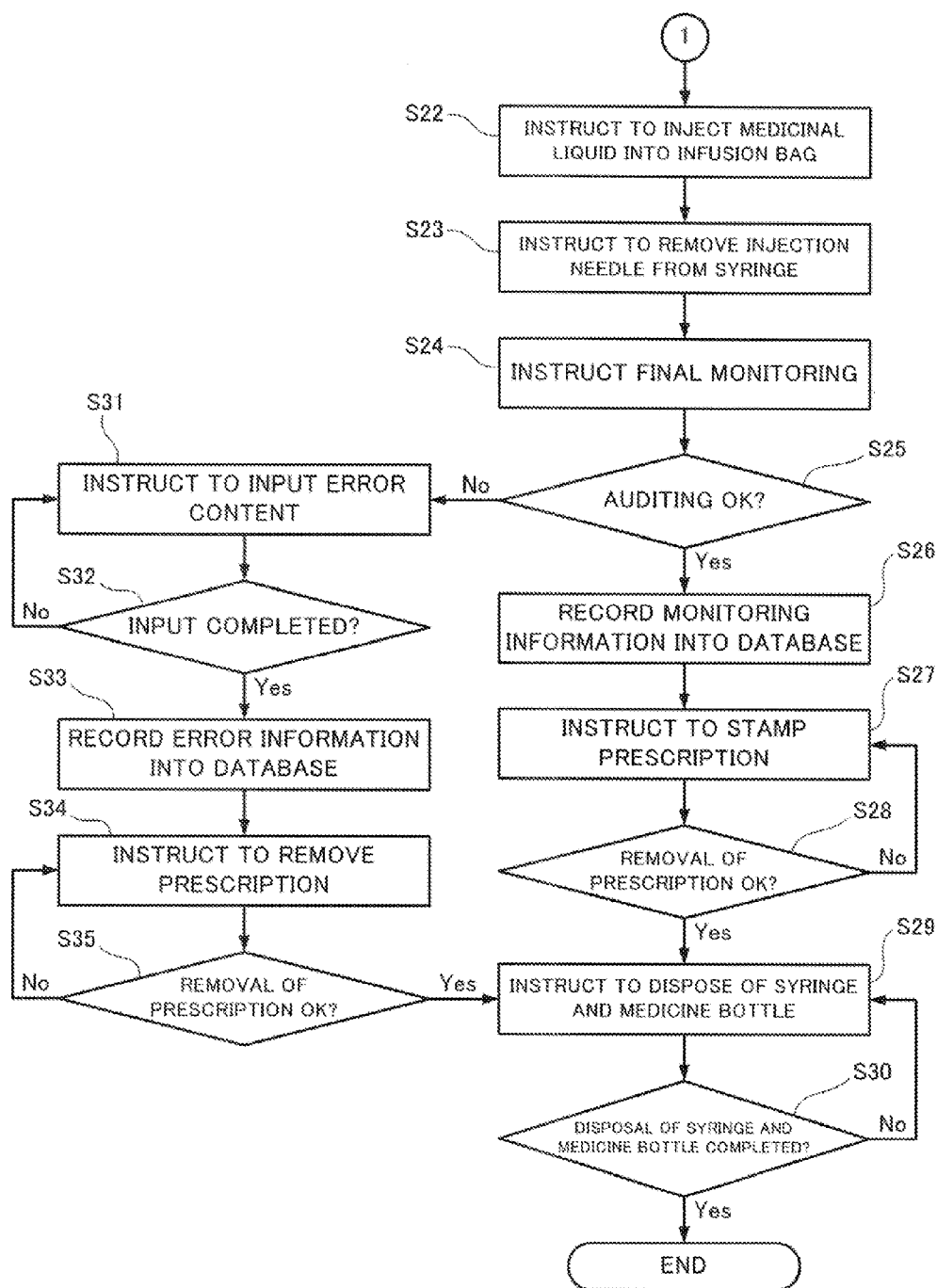


FIG. 10

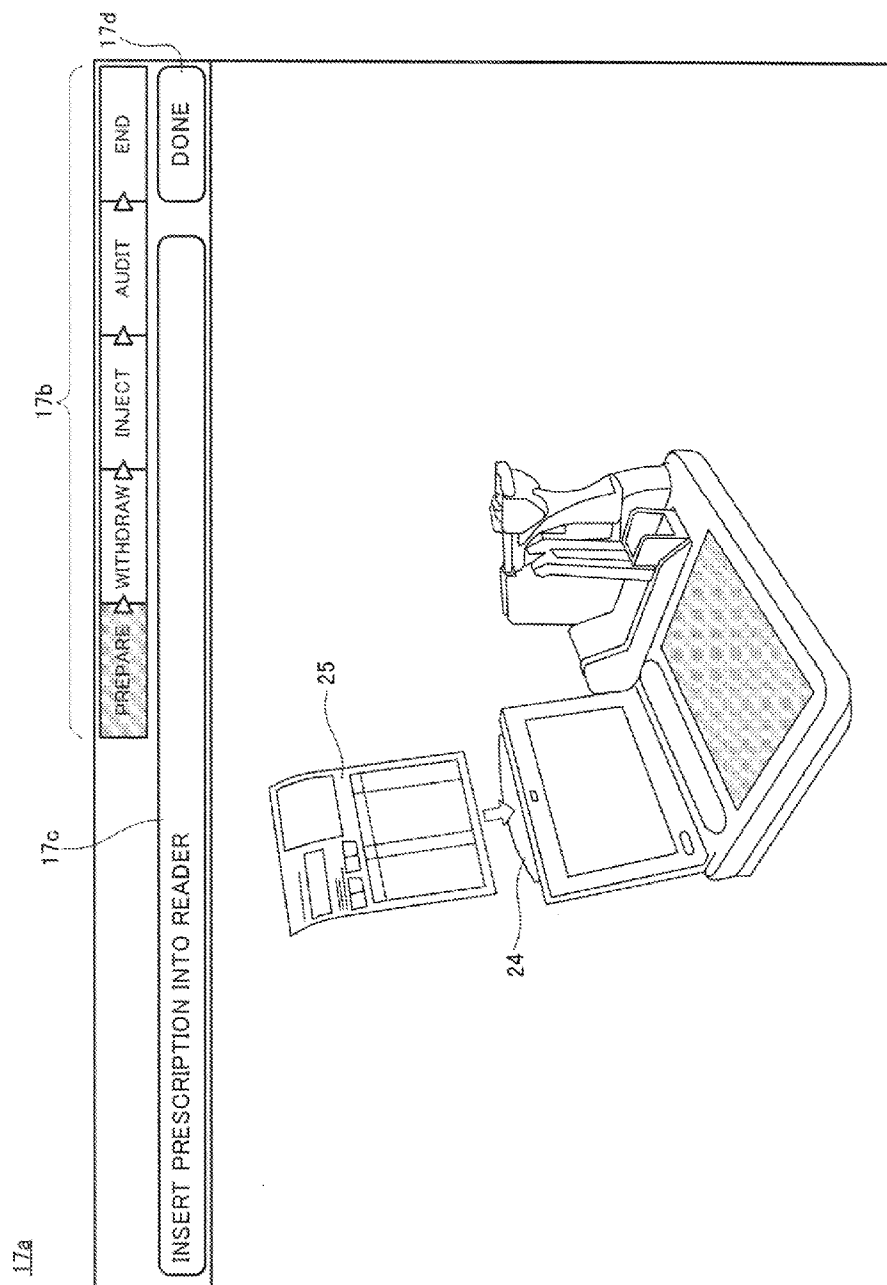
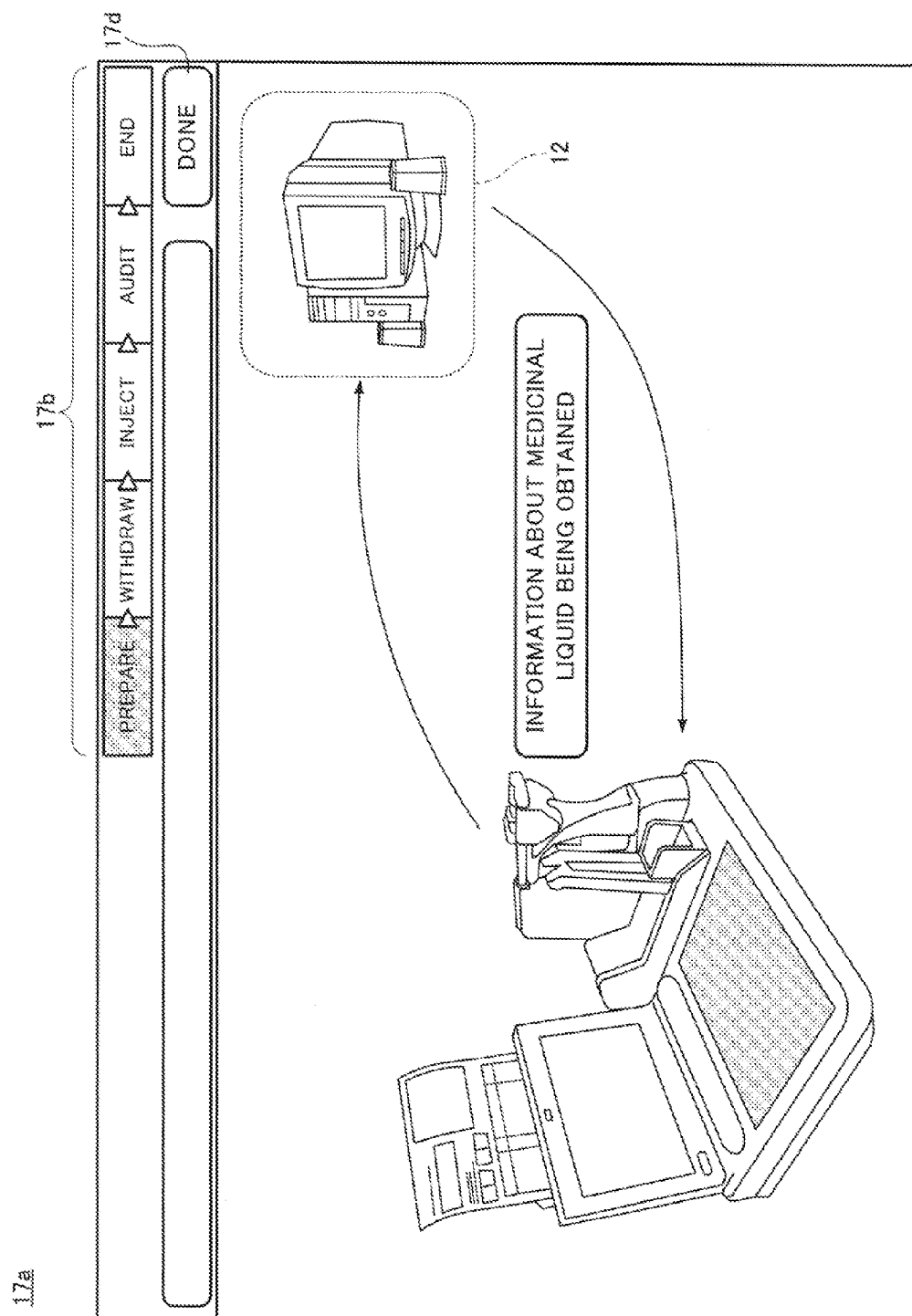


FIG. 11



2
7
6
5

PREPARE
WITHDRAW
INJECT
AUDIT
END

17a
17b
17c

SET THE MEDICINE BOTTLE AND INFUSION BAG ACCORDING TO DISPLAY CONTENT

PATIENT NUMBER	0000-42-6
HOSPITAL ROOM	300

FURIGANA	O Δ □ ×
NAME	O Δ □ ×

AGE	53-03
DATE OF BIRTH	A31-04-01 M40

DATE AND HOUR OF ISSUE	09.07.29 14:52
DATE AND HOUR OF ADMINISTRATION	09.07.30 08:15

DEPARTMENT	53 RESPIRATORY SURGERY
DOCTOR	◇ ◇ Δ Δ

MEDICINAL LIQUID A 5mg	AMOUNT: 1V
---------------------------	------------

MEDICINAL LIQUID B 5mg/1ml	AMOUNT: 1A
-------------------------------	------------

MEDICINAL LIQUID C 5mg	AMOUNT: 1V
---------------------------	------------

AMOUNT: 1V	AMOUNT: 1V
------------	------------

AMOUNT: 1V	AMOUNT: 1V
------------	------------

AMOUNT: 1V	AMOUNT: 1V
------------	------------

3
4
5
6
7

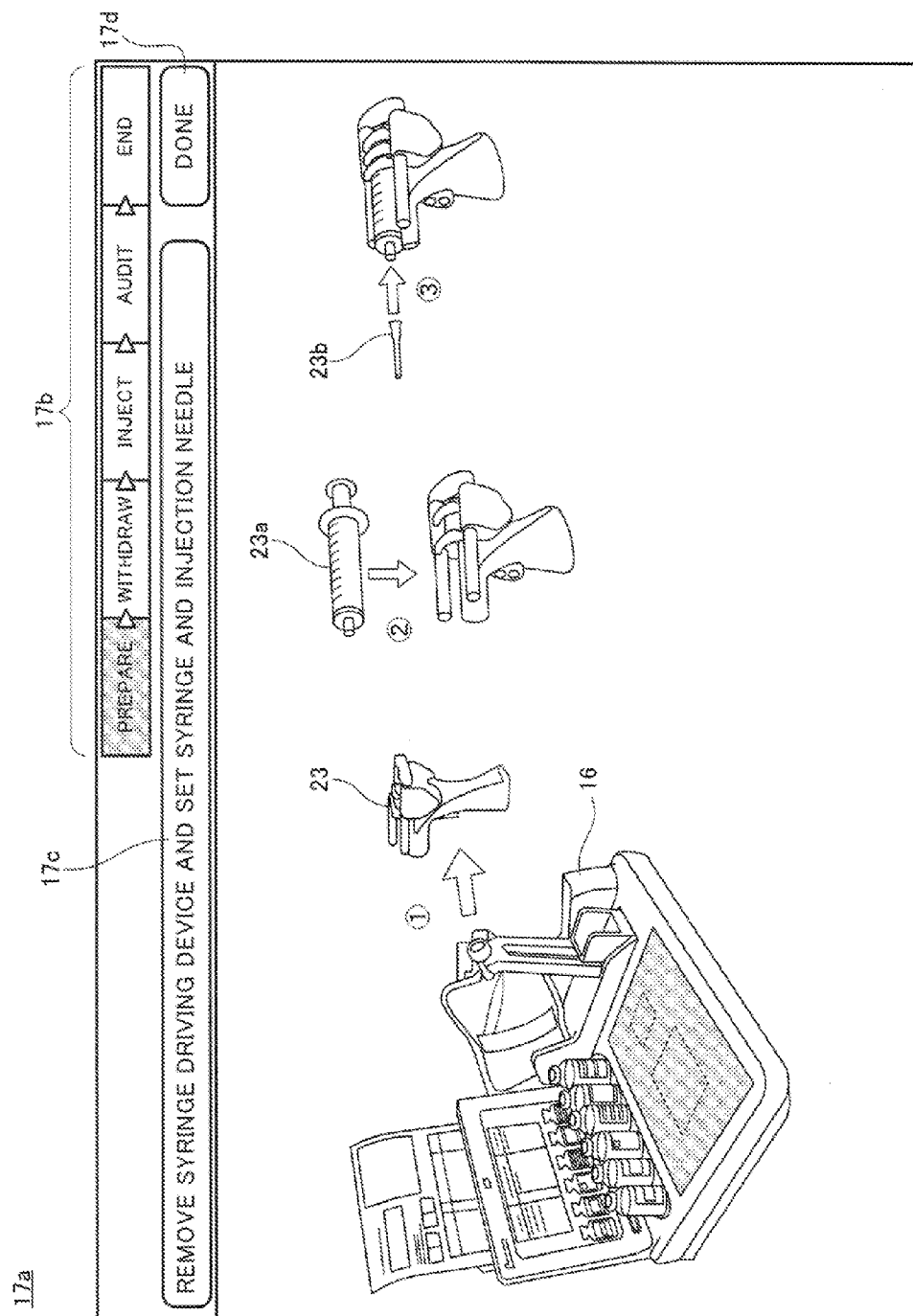


FIG. 14

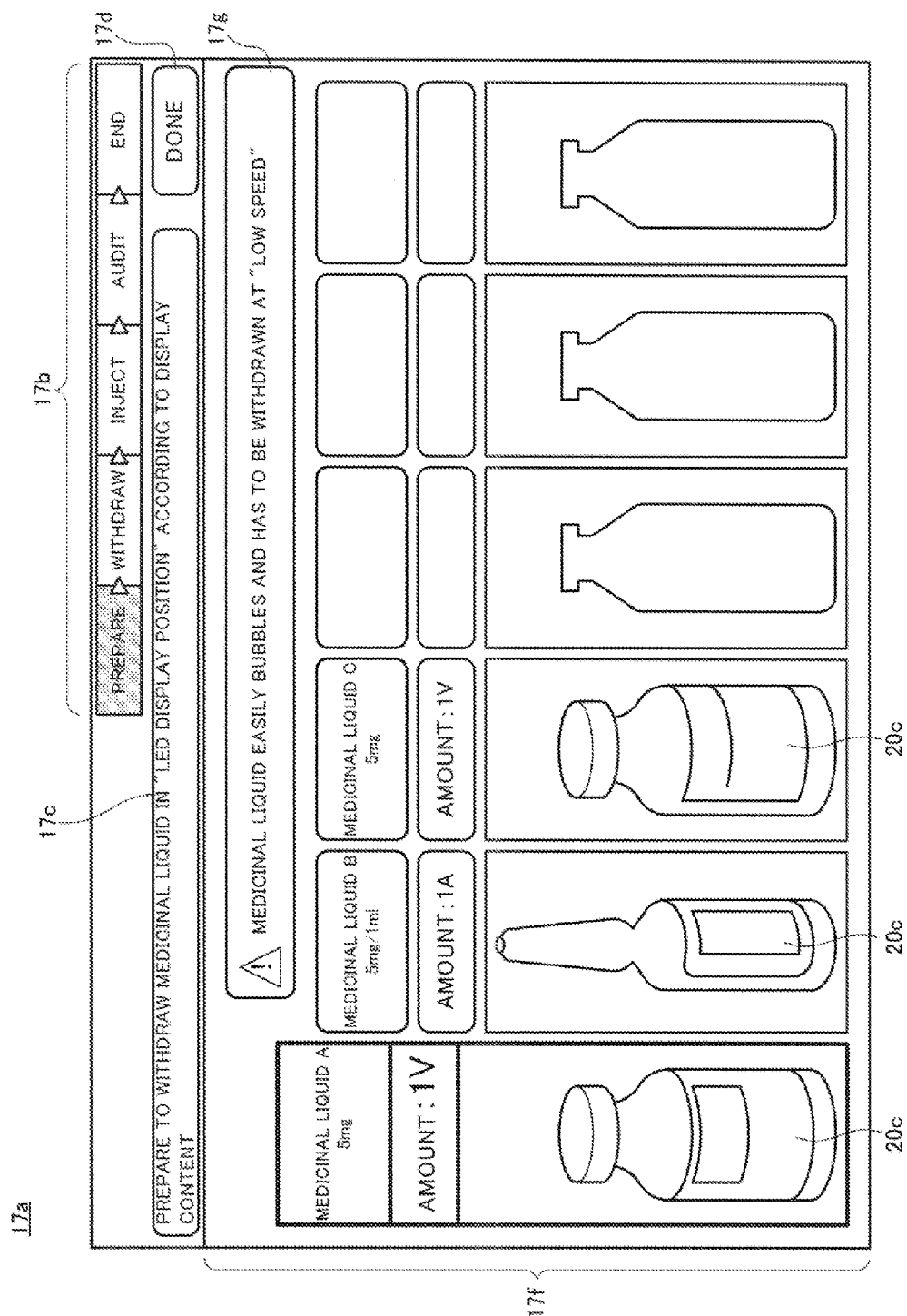


FIG. 15

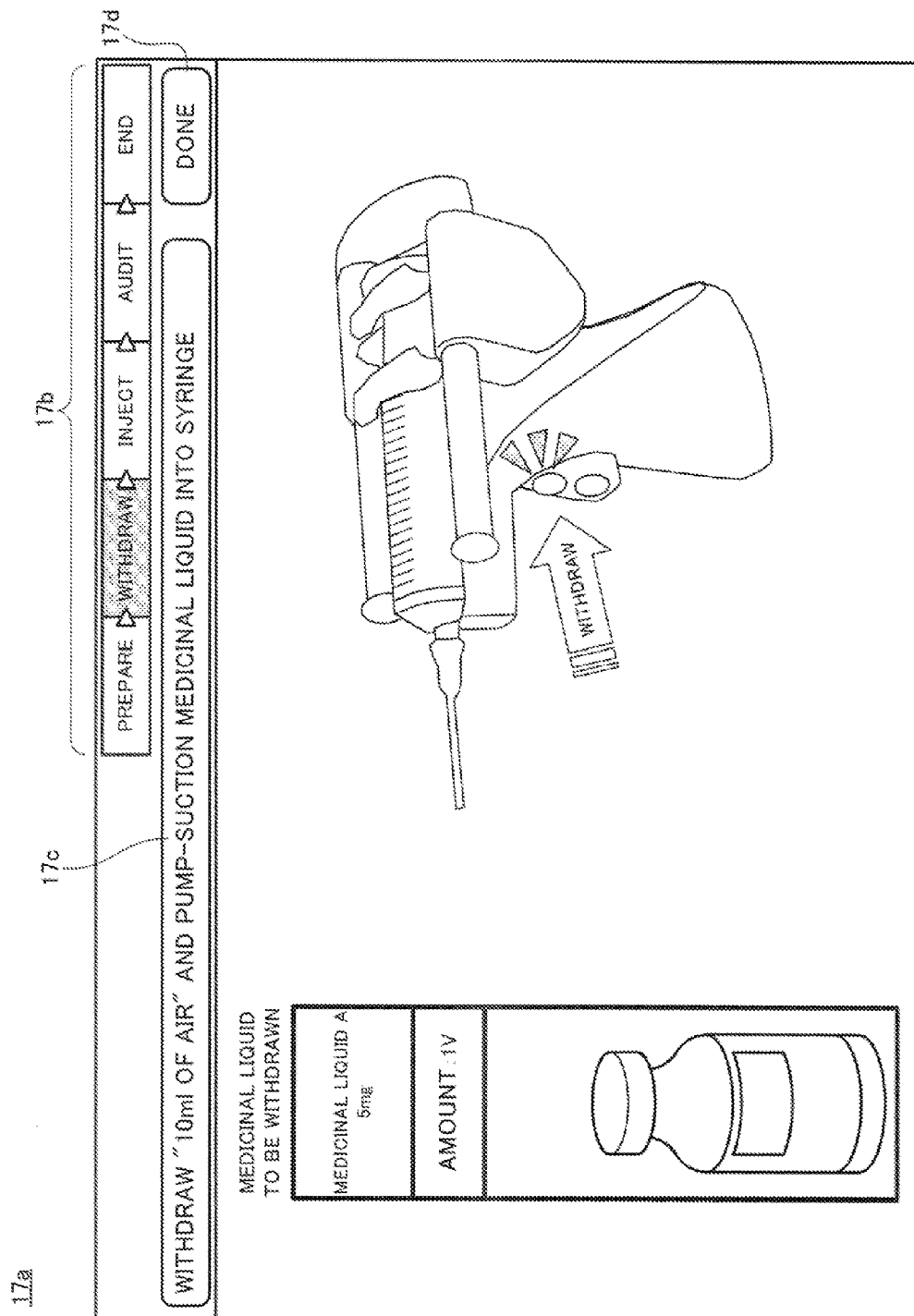


FIG. 16

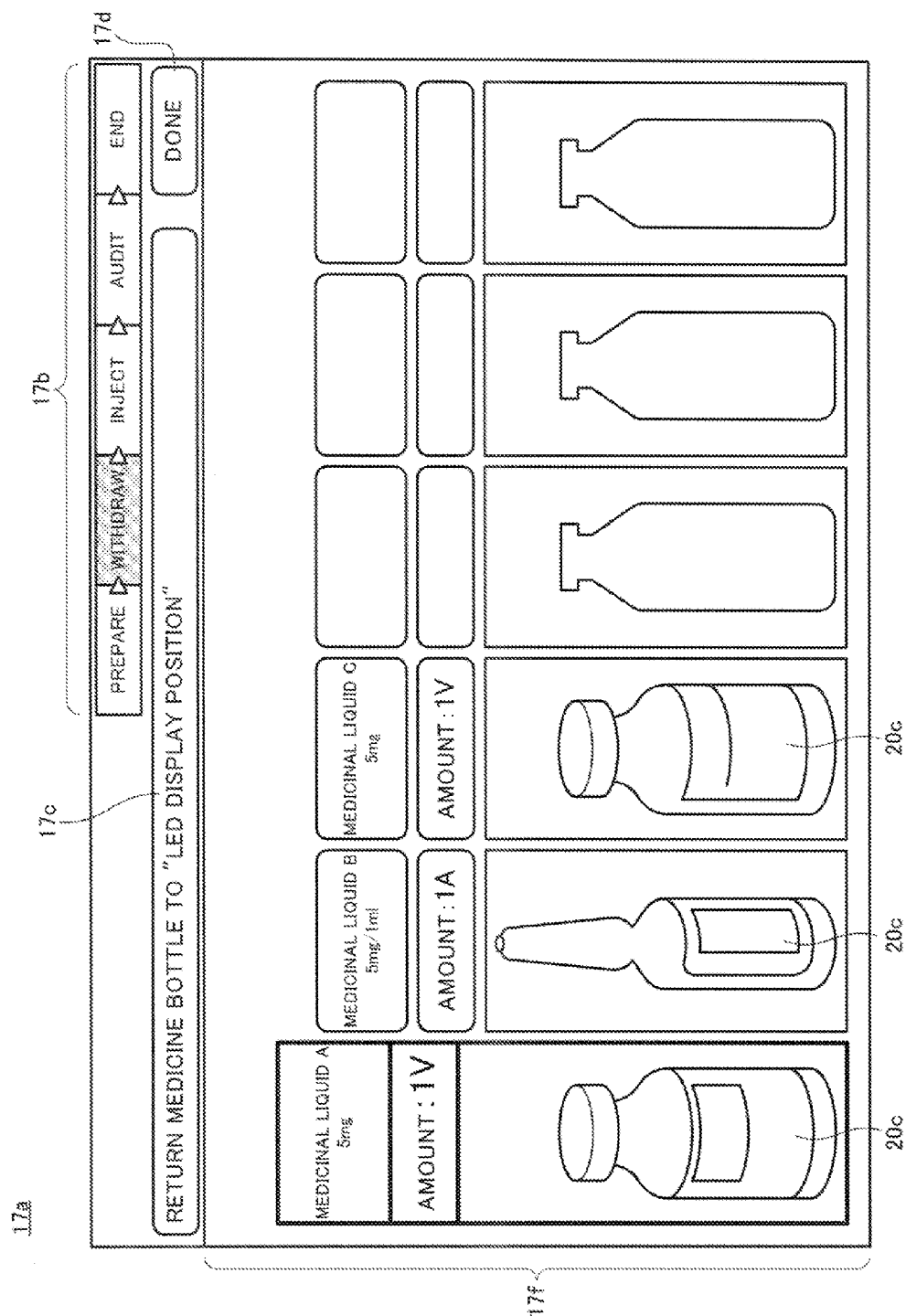


FIG. 17

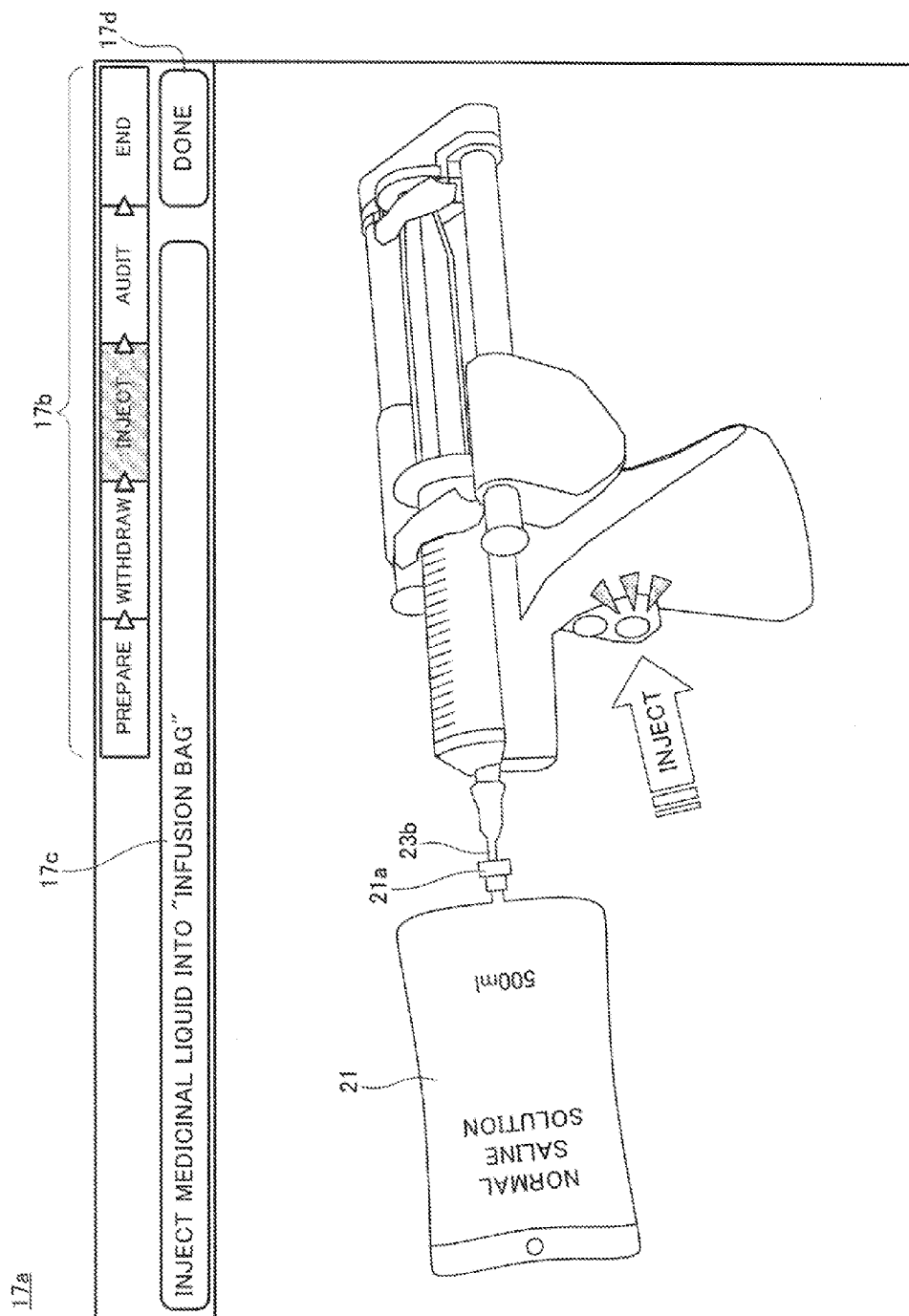


FIG. 18

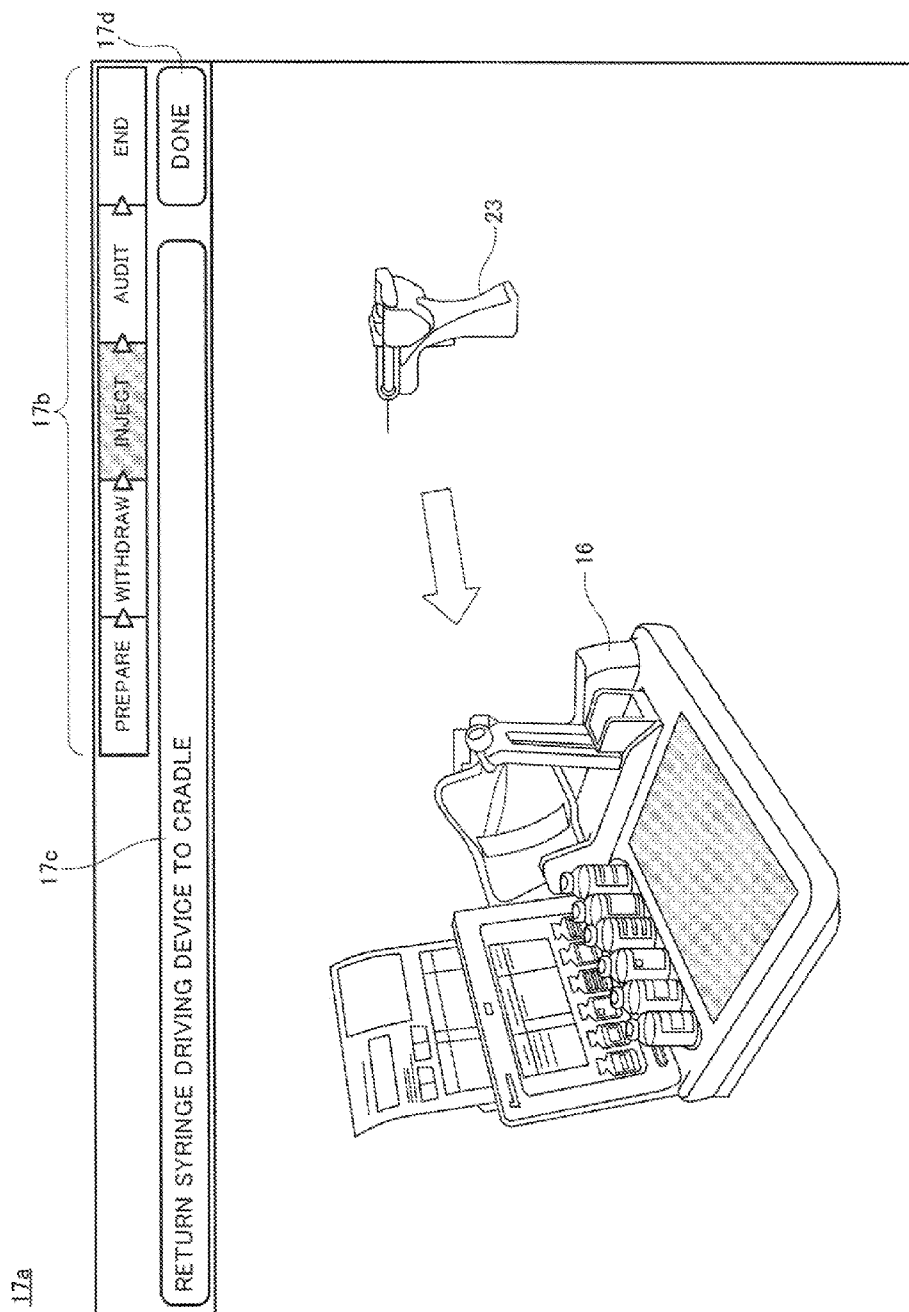


FIG. 19

17a

17c

17b

17d

PRESS DONE BUTTON AFTER CONFIRMING AUDITING RESULT

PREPARE WITHDRAW INJECT AUDIT END

DONE

PATIENT NUMBER 0000-42-6		DEPARTMENT 53 RESPIRATORY SURGERY		DOCTOR ◇◇ △△	
FURIGANA O△ □x HOSPITAL ROOM 300					
NAME O△ □x					
DATE OF BIRTH A31-04-01 M40		DATE AND HOUR OF ISSUE 09.07.29 14:52			
AGE 53-03		DATE AND HOUR OF ADMINISTRATION 09.07.30 08:15			
RP	MEDICINAL LIQUID NAME (STANDARD)	DIRECTION	DOSAGE	UNIT	CONFIRMATION
1	SINGLE TIME	A INTRAVENOUS			
	1. MEDICINAL LIQUID A	DRIP INFUSION	5mg	1V	
	2. MEDICINAL LIQUID B		5mg/ml	1A	
	3. MEDICINAL LIQUID C		5mg	1V	

FIG. 20

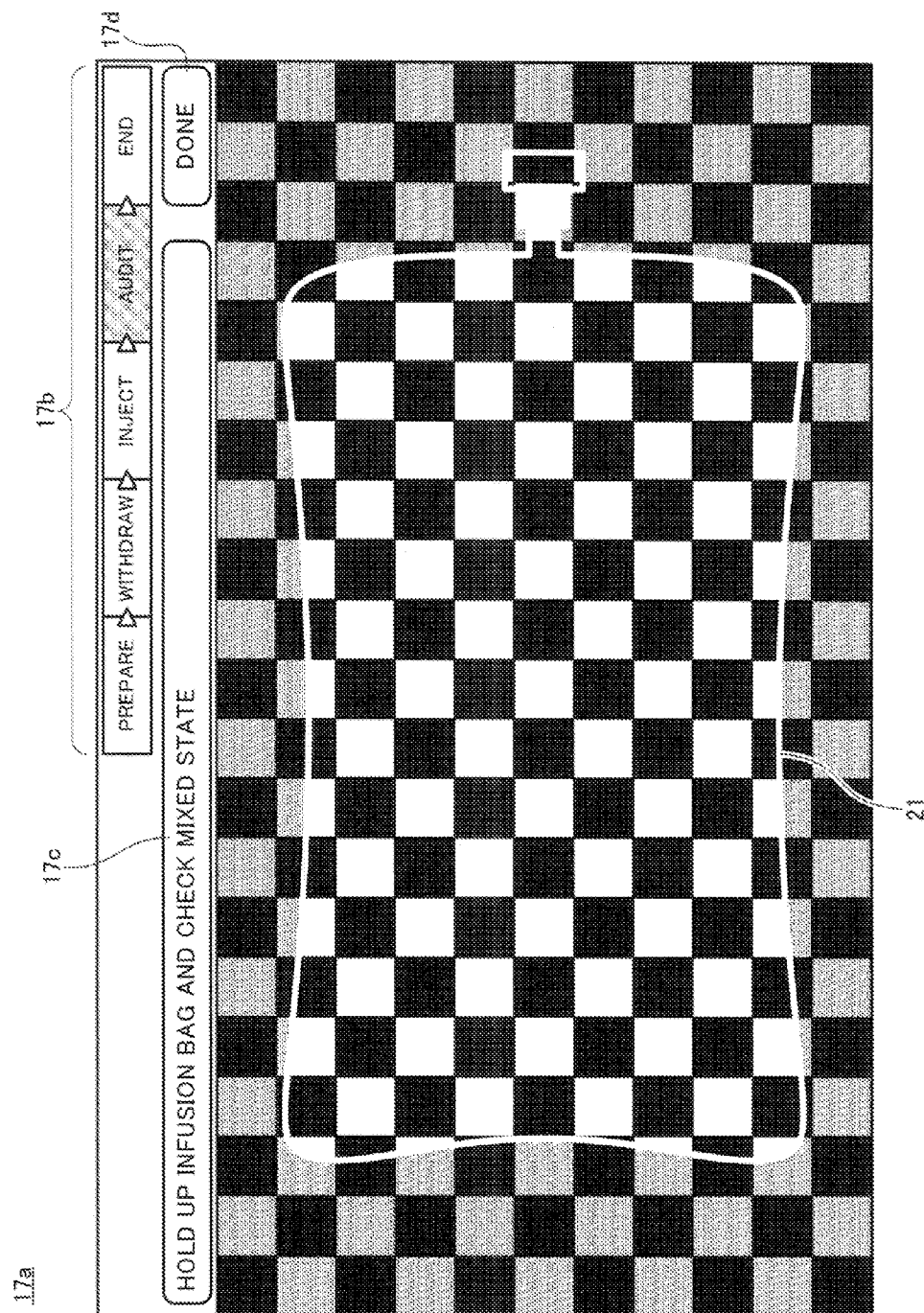


FIG. 21

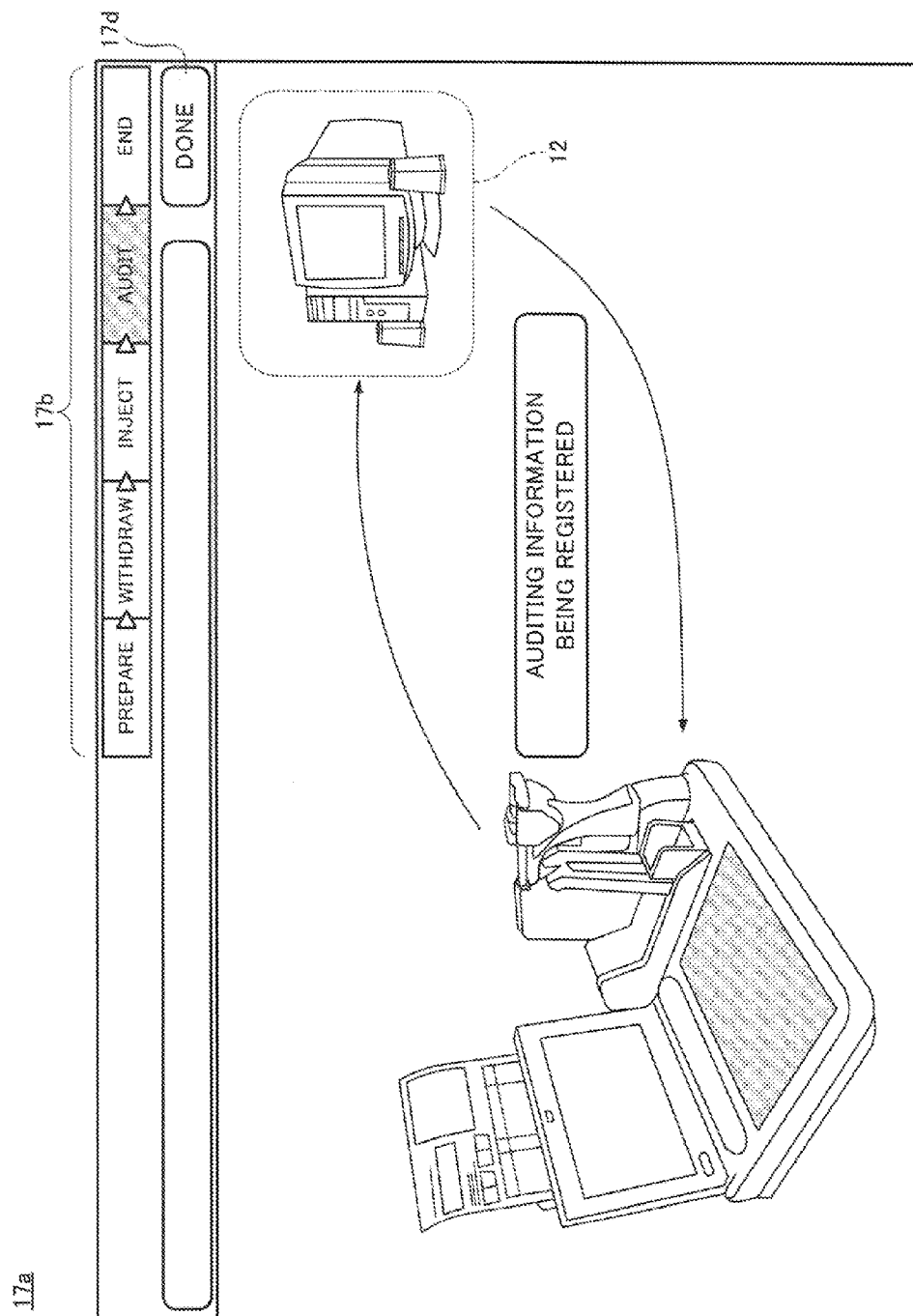


FIG. 22

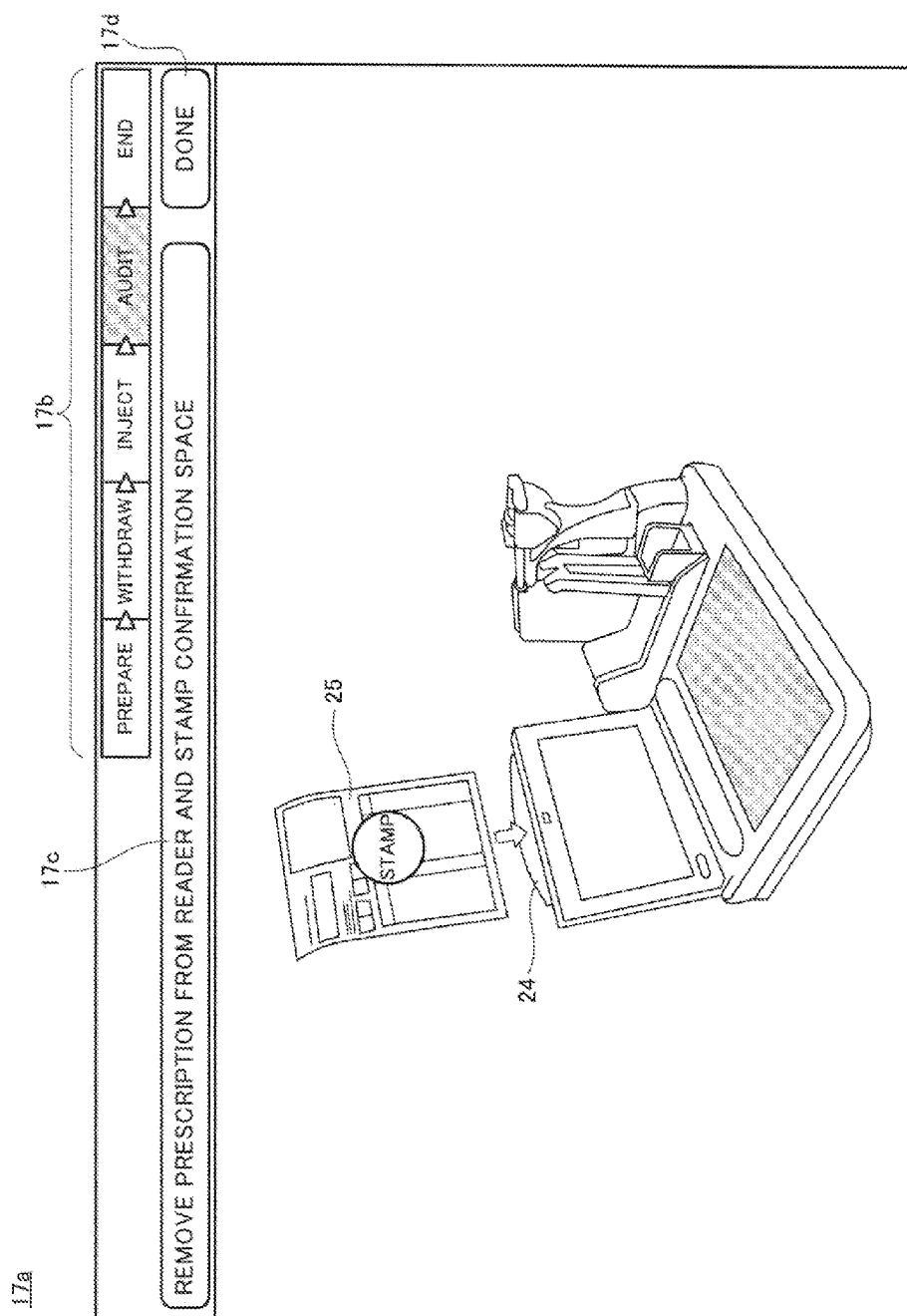
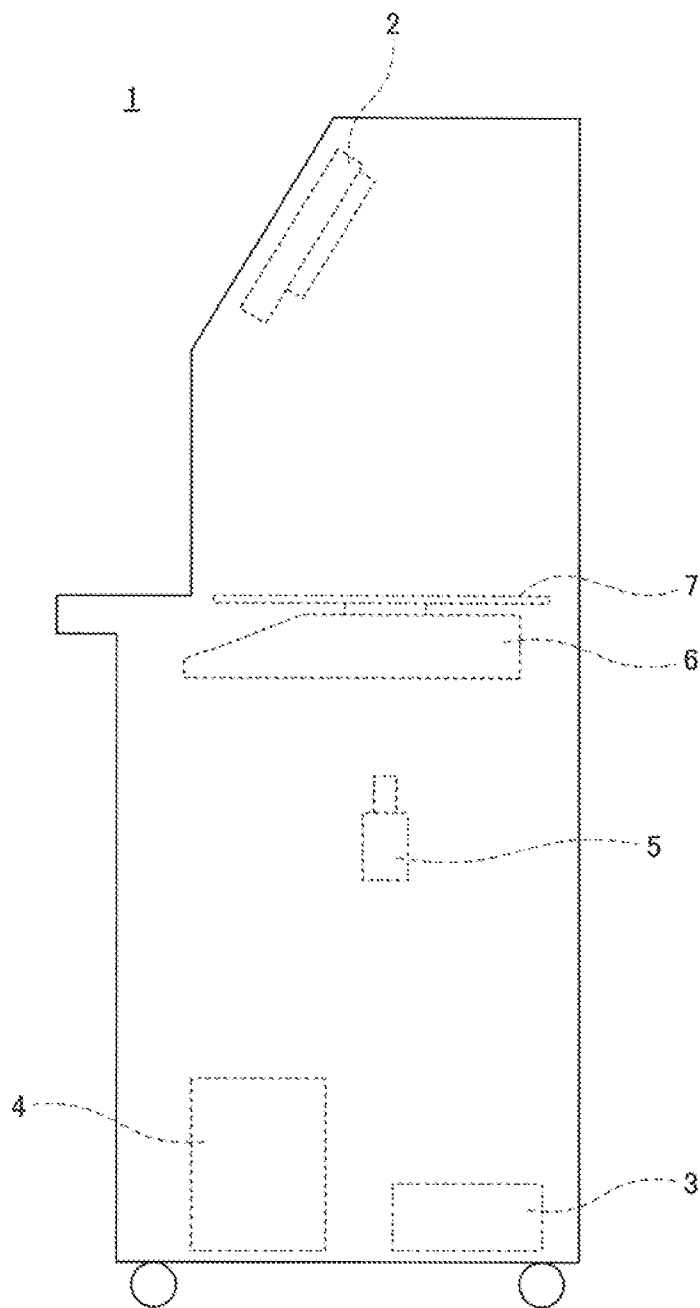


FIG. 23

PRIOR ART



SYSTEM FOR ASSISTING MEDICINAL LIQUID PREPARATION AND METHOD FOR ASSISTING MEDICINAL LIQUID PREPARATION

TECHNICAL FIELD

[0001] The present invention relates to systems and methods for assisting medicinal liquid preparation which are used for auditing in injecting medicinal liquids such as injection drugs into an infusion bag in the field of medicine.

BACKGROUND ART

[0002] In many cases, medicinal liquids taken and mixed from several types of medicinal liquid containers are administered to hospitalized patients and so on. When several types of medicinal liquids are to be mixed, the types of the medicinal liquids have to be confirmed in the setting of the medicinal liquids. Especially in the case where medicinal liquids are administered to hospitalized patients, the types of medicinal liquids have to be sufficiently confirmed, and errors in the setting of medicinal liquids have to be prevented. This is because some of medicinal liquids administered to hospitalized patients have to be handled with sufficient attention to safety.

[0003] Further, when medicinal liquids are to be mixed, the medicinal liquids are withdrawn from medicinal liquid containers (medicine bottles) into a syringe and injected into an infusion bag. During this operation, the amounts of the withdrawn medicinal liquids have to be confirmed sufficiently. In particular, it is necessary to sufficiently confirm the amounts of medicinal liquids which are harmful to humans if taken in improper amounts.

[0004] Further, when medicinal liquids are to be mixed, the types of the medicinal liquids have to be confirmed. This is because desired effects of medicine cannot be obtained or the mixed medicinal liquids become clouded when medicinal liquid containers are erroneously picked up or the medicinal liquids are mixed and prepared in the wrong order.

[0005] Generally, the types and amounts of medicinal liquids are visually confirmed by nurses and pharmacists. Thus, prevention of errors in the setting and amounts of medicinal liquids and errors in the selection of medicine liquid containers puts a heavy workload on nurses and pharmacists.

[0006] Moreover, in general, medicinal liquids are manually mixed by nurses or pharmacists. When a medicinal liquid is taken out of a medicinal liquid container, an injection needle is inserted into the medicinal liquid container by a nurse or pharmacist to withdraw the medicinal liquid. However, when a medicinal liquid having high viscosity such as glucose is withdrawn, a large force is required for operating a syringe. Furthermore, when a medicinal liquid is withdrawn from a vial container requiring the adjustment of internal pressure, a complicated procedure is necessary. Thus, the operation of taking medicinal liquids from medicinal liquid containers puts a heavy workload on nurses and pharmacists.

[0007] For the foregoing reasons, the development of an assist system for reducing the workload on nurses and pharmacists has been demanded.

[0008] FIG. 23 shows a medicine auditing apparatus of the related art used in setting drugs (for example, see Patent Literature 1). This medicine auditing apparatus 1 is used for

assisting in checking drugs in the setting of the drugs. The following will describe an auditing method using the medicine auditing apparatus 1.

[0009] An operator such as a nurse or a pharmacist first inputs preparation data to a data entry and display device 2. Based on the inputted preparation data to the data entry and display device 2, a storage and analysis device 3 sends image and weight data of drugs required for the preparation to a comparison determination device 4. The storage and analysis device 3 stores image and weight data of drugs used for hospitals and dispensing pharmacies beforehand. The image and weight data of drugs stored in the storage and analysis device 3 is prepared by an image data recognizing device 5 and a weight measuring device 6 beforehand.

[0010] Thereafter, the operator puts the drugs required for the preparation one by one on a medicine set stage 7. The medicine auditing apparatus 1 performs the following processing for each drug on the medicine set stage 7. Specifically, the image data recognizing device 5 prepares the image data of the drug on the medicine set stage 7, and sends the prepared image data to the comparison determination device 4. The comparison determination device 4 compares the image data of the drug on the medicine set stage 7 with the image data from the storage and analysis device 3 to perform determination. The determination result (OK, NG) is sent to the data entry and display device 2. Further, when they determination result is OK, the weight measuring device 6 prepares the weight data of the drug on the medicine set stage 7, and sends the prepared weight data to the comparison determination device 4. The comparison determination device 4 compares the weight data of the drug on the medicine set stage 7 with the weight data from the storage and analysis device 3 to perform determination. The determination result (OK, NG) is sent to the data entry and display device 2.

[0011] As described above, the medicine auditing apparatus of the related art assists in auditing in checking whether or not the set drugs are correct, by automatically evaluating the appearance and weight of the set drugs. This auditing can prevent errors in the setting of drugs.

CITATION LIST

Patent Literature

[0012] Patent Literature 1: Japanese Patent Application Laid-Open Publication No. 2005-279228

SUMMARY OF INVENTION

Technical Problem

[0013] As described above, the medicine auditing apparatus of the related art can be used for auditing in setting drug containers. However, the medicine auditing device of the related art cannot be used for auditing in preparing medicinal liquids by mixing and so on.

[0014] An object of the present invention is to solve the above-described problem. Specifically, the object of the present invention is to provide a system and method for assisting medicinal liquid preparation which can assist in auditing the amounts of injected medicinal liquids and so on in preparing the medicinal liquids.

Solution to Problem

[0015] In order to attain the object, a medicinal liquid preparation assist system according to the present invention

includes: a medicine bottle weight measurement unit having a medicine bottle mounting portion on which medicine bottles are placed, and a first weight measurement portion for measuring the total weight of all the medicine bottles placed on the medicine bottle mounting portion; an infusion bag weight measurement unit having an infusion bag mounting portion on which an infusion bag is placed, and a second weight measurement portion for measuring the weight of the infusion bag placed on the infusion bag mounting portion; a storage unit; a control unit for producing auditing information based on changes in weight measured by the medicine bottle weight measurement unit and the infusion bag weight measurement unit, and storing the produced auditing information in the storage unit; and an information presentation unit for displaying at least one of information about medicinal liquids to be injected into the infusion bag, the information being stored beforehand in the storage unit, and the auditing information stored in the storage unit by the control unit.

[0016] A method for assisting medicinal liquid preparation according to the present invention, the method includes: a display step of displaying information about medicinal liquids to be injected into an infusion bag, the information stored in a storage unit; a medicine bottle weight measuring step of measuring the total weight of medicine bottles placed on a medicine bottle mounting portion; an infusion bag weight measuring step of measuring the weight of the infusion bag placed on an infusion bag mounting portion; a first auditing information producing step of producing auditing information based on changes in weight measured by the medicine bottle weight measuring step, and storing the produced auditing information in the storage unit; and a second auditing information producing step of producing auditing information based on changes in weight measured by the infusion bag weight measuring step, and storing the produced auditing information in the storage unit.

Advantageous Effects of Invention

[0017] According to the present invention, auditing in the amounts of withdrawn medicinal liquids, the mixing and preparing order of medicinal liquids, the amounts of injected medicinal liquids, and so on can be assisted when preparing medicinal liquids. Thus, according to the present invention, errors in the selection of medicine bottles and the amounts of medicinal liquids can be prevented. Hence, according to the present invention, safe and accurate preparation of medicinal liquids can be achieved.

BRIEF DESCRIPTION OF DRAWINGS

[0018] FIG. 1 is a perspective view schematically showing the configuration of a medicinal liquid preparation assist system according to an embodiment of the present invention.

[0019] FIG. 2 shows the main parts of a medicine bottle weight measurement unit and an infusion bag weight measurement unit according to the embodiment.

[0020] FIG. 3 shows an example of an image appearing on the display of an information presentation unit according to the embodiment.

[0021] FIG. 4 shows an example of changes in weight measured by the medicine bottle measurement unit according to the embodiment.

[0022] FIG. 5 shows an example of changes in weight measured by the medicine bottle measurement unit according to the embodiment.

[0023] FIG. 6 shows an example of changes in weight measured by the medicine bottle measurement unit according to the embodiment.

[0024] FIG. 7 is a flowchart of a method for assisting medicinal liquid preparation according to the embodiment.

[0025] FIG. 8 is a flowchart of a specific example of the method for assisting medicinal liquid preparation according to the embodiment.

[0026] FIG. 9 is a flowchart of a specific example of the method for assisting medicinal liquid preparation according to the embodiment.

[0027] FIG. 10 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0028] FIG. 11 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0029] FIG. 12 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0030] FIG. 13 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0031] FIG. 14 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0032] FIG. 15 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0033] FIG. 16 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0034] FIG. 17 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0035] FIG. 18 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0036] FIG. 19 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0037] FIG. 20 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0038] FIG. 21 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0039] FIG. 22 shows an example of an image appearing on the display of the information presentation unit according to the embodiment.

[0040] FIG. 23 is a configuration diagram of a medicine auditing apparatus according to the related art.

DESCRIPTION OF EMBODIMENTS

[0041] Referring to the accompanying drawings, the following will describe an embodiment of the present invention. The same components are indicated by the same reference numerals, and an explanation thereof is omitted in some cases. In the drawings, the components are primarily and schematically shown for the sake of simplicity.

[0042] FIG. 1 is a perspective view schematically showing the configuration of a medicinal liquid preparation assist system in accordance with the embodiment of the present invention. As shown in FIG. 1, a medicinal liquid preparation assist

system 10 according to the embodiment includes a medicinal liquid preparation assist apparatus 11 and a medical information database 12 connected to the medicinal liquid preparation assist apparatus 11 via a network.

[0043] The medicinal liquid preparation assist apparatus 11 includes a base 13. The base 13 includes a medicine bottle weight measurement unit 14, an infusion bag weight measurement unit 15, a cradle 16, and an information presentation unit 17. In addition, the casing of the base 13 includes a control unit 18 and a storage unit 19 therein as indicated by the dash lines.

[0044] FIG. 2 shows the main parts of the medicine bottle weight measurement unit and the infusion bag weight measurement unit in accordance with the embodiment of the present invention.

[0045] As shown in FIG. 2, the medicine bottle weight measurement unit 14 has a medicine bottle mounting portion 14a on which a plurality of medicine bottles 20 can be placed and a weight measurement portion 14b which measures the total weight of the medicine bottles 20 on the medicine bottle mounting portion 14a. The weight measurement portion 14b is disposed vertically under the medicine bottle mounting portion 14a.

[0046] FIG. 2 illustrates that two vial containers 20a and four ampule containers 20b all of which are different in shape on the medicine bottle mounting portion 14a. FIG. 1 shows a configuration in which a maximum of six medicine bottles 20 can be mounted on the medicine bottle mounting portion of the medicine bottle weight measurement unit 14, but as a matter of course, the number of medicine bottles to be mounted on the medicine bottle mounting portion of the medicine bottle weight measurement unit 14 is not limited to six.

[0047] As shown in FIG. 2, the infusion bag weight measurement unit 15 has an infusion bag mounting portion 15a on which an infusion bag 21 to be injected with a medicinal liquid is placed and a weight measurement portion 15b which measures the weight of the infusion bag 21 placed on the infusion bag mounting portion 15a. The weight measurement portion 15b is disposed vertically under the infusion bag mounting portion 15a. The infusion bag 21 to be placed on the infusion bag mounting portion 15a is filled with normal saline solution beforehand.

[0048] As shown in FIG. 1, the infusion bag mounting portion of the infusion bag weight measurement unit 15 includes a support 15c which supports a spout plug 21a of the infusion bag 21 and the vicinity thereof. The infusion bag 21 is supported by the support 15c such that a spout plug face 21b is directed obliquely upward.

[0049] The injection needle of a syringe is easily inserted into the spout plug 21a of the infusion bag 21 with the spout plug face 21b of the infusion bag 21 directed obliquely upward, when a medicinal liquid in the syringe is injected into the infusion bag 21.

[0050] In some cases, an injection needle is inserted into the spout plug 21a of the infusion bag 21 beforehand, and a syringe is fitted to the injection needle inserted into the spout plug 21a to inject a medicinal liquid into the infusion bag 21. This eliminates the need to repeatedly insert or remove an injection needle into or from the spout plug 21a of the infusion bag 21, thereby preventing coring caused by the insertion or removal of an injection needle. Coring is a phenomenon in which a rubber plug is chipped off by an injection needle. In such a case where a medicinal liquid is injected from a syringe

into the infusion bag with an injection needle inserted into the spout plug 21a of the fluid bag 21, the injection needle can be prevented from being contaminated by contact with things other than the syringe so long as the spout plug face 21b of the infusion bag 21 is directed obliquely upward.

[0051] As shown in FIG. 2, the control unit 18 is connected to the medicine bottle weight measurement unit 14 and the infusion bag weight measurement unit 15 via signal lines 22a. Data of weight measured by the medicine bottle weight measurement unit 14 and the infusion bag weight measurement unit 15 is sent to the control unit 18 via the signal lines 22a. The control unit 18 produces auditing information indicating the results of auditing on the preparation of medicinal liquids in accordance with changes in weight measured by the medicine bottle weight measurement unit 14 and the infusion bag weight measurement unit 15. The storage unit 19 is connected to the control unit 18 via a signal line 22b, and the control unit 18 causes the auditing information to be stored in the storage unit 19. The auditing information is produced and is stored in the storage unit 19 automatically, so that the results of auditing can be automatically recorded and accumulated. In the related art, the results of auditing are manually recorded and accumulated. This automation can improve the efficiency of preparing medicinal liquids.

[0052] In this embodiment, the total weight of the medicine bottles 20 on the medicine bottle mounting portion 14a is measured, but the weight of the medicine bottles 20 on the medicine bottle mounting portion 14a may be measured individually by using a plurality of measurement devices. However, the number of sensors can be reduced by measuring the total weight of the medicine bottles 20 rather than by measuring the weight of the medicine bottles individually.

[0053] The medicinal liquid preparation assist system 10 having the above-described configuration can assist in auditing counting of medicine bottles, checking of types of medicine bottles (types of medicinal liquids), the mixing and preparing order of medicinal liquids, measuring of medicinal liquids, and so on, based on the changes in weight measured by the medicine bottle weight measurement unit 14 and the infusion bag weight measurement unit 15. These auditing processes can prevent errors in the setting of medicine bottles, the selection of medicine bottles and the amounts of medicinal liquids at the time of preparing medicinal liquids, and so forth. Thus, medicinal liquids can be safely and accurately prepared by the medicinal liquid preparation assist system 10. Operations of the medicinal liquid preparation assist system 10 for the auditing processes will be explained later.

[0054] The following will describe the cradle 16. As shown in FIG. 1, the cradle 16 supports a syringe driving device 23. The syringe driving device 23 drives the piston of a syringe 23a mounted on the syringe driving device 23. The syringe driving device 23 assists in withdrawing a medicinal liquid into the cylinder of the syringe 23a and injecting the medicinal liquid from the cylinder of the syringe 23a into the infusion bag 21.

[0055] Specifically, the cradle 16 includes a holder 16a holding the syringe driving device 23, and a weight measurement portion (not shown) which measures the weight of the syringe driving device 23 held by the holder 16a. The cradle 16 serves as a syringe weight measurement portion in the medicinal liquid preparation assist system 10.

[0056] The weight measurement portion of the cradle 16 is disposed vertically under the holder 16a holding the syringe driving device 23, similarly to the weight measurement portion

tion **14b** of the medicine bottle weight measurement unit **14** and the weight measurement portion **15b** of the infusion bag weight measurement unit **15** shown in FIG. 2.

[0057] The weight measurement portion of the cradle **16** is also connected to the control unit **18** via a signal line, similarly to the weight measurement portion **14b** of the medicine bottle weight measurement unit **14** and the weight measurement portion **15b** of the infusion bag weight measurement unit **15** shown in FIG. 2. Thus, data of weight measured by the weight measurement portion of the cradle **16** is sent to the control unit **18**. Hence, the control unit **18** produces auditing information indicating the results of auditing on the preparation of medicinal liquids based on weight measured by the cradle **16**, and causes the produced auditing information to be stored in the storage unit **19**.

[0058] The holder **16a** of the cradle **16** has a charger (not shown) which charges the syringe driving device **23**. Thus, the power supply (not shown) of the syringe driving device **23** is charged while the syringe driving device **23** is held by the cradle **16**.

[0059] The medicinal liquid preparation assist system **10** including the cradle **16** can assist in auditing whether or not a medicinal liquid is left in the syringe **23a** and the amount of a medicinal liquid withdrawn into the syringe **23a**. The auditing processes can prevent errors in the selection of medicine bottles, the amounts of medicinal liquids, and so forth in preparing medicinal liquids. Operations of the medicinal liquid preparation assist system **10** for the auditing processes in accordance with the weight measured by the cradle **16** will be explained later.

[0060] A needle removing portion (not shown) may be also provided on the cradle **16** for removing a used injection needle from the syringe **23a**. The needle removing portion may be composed of, for example, a flat plate with a V-groove. A needle can be removed from the syringe **23a** with the flange of the syringe **23a** hooked in the V-groove. The provision of such a needle removing portion enables an operator such as a nurse or a pharmacist to remove a used injection needle without touching the needle. Thus, needle-stick accidents can be avoided in removing used injection needles.

[0061] The following will describe the information presentation unit **17**. As shown in FIG. 1, the information presentation unit **17** includes a display **17a**. The control unit **18** controls images on the display **17a** in accordance with a variety of information stored in the storage unit **19**. In this embodiment, the display **17a** of the information presentation unit **17** displays information about medicinal liquids to be injected into the infusion bag **21**, auditing information, information about a patient to whom the prepared medicinal liquids are administered, and so forth. The information about medicinal liquids includes information needed for the preparation of medicinal liquids such as the types of medicinal liquids, the doses of medicinal liquids, and the preparing order of medicinal liquids. Incidentally, the information presentation unit **17** may display any one of the information about medicinal liquids and the auditing information.

[0062] The medicinal liquid preparation assist system **10** including the information presentation unit **17**, can visually provide an operator with information such as the types of medicinal liquids to be injected into the infusion bag **21** and the mixing and preparing order of medicinal liquids. Thus, the operator can easily and accurately confirm information

required for the preparation of medicinal liquids. The operator can also prepare medicinal liquids efficiently.

[0063] The following will describe the base **13**. As shown in FIG. 1, the base **13** is integrated with the medicine bottle weight measurement unit **14**, the infusion bag weight measurement unit **15**, and the cradle **16**. The base **13** further includes a work board **13a** (area for mixing and preparing) disposed adjacent to the medicine bottle weight measurement unit **14** and the infusion bag weight measurement unit **15**. An operator such as a nurse or a pharmacist can prepare medicinal liquids on the work board **13a**. As described above, the information presentation unit **17** is provided on the base **13**, and the casing of the base **13** includes the control unit **18** and the storage unit **19** therein. This configuration enables the size reduction of the medicinal liquid preparation assist apparatus **11**. Thus, an operator can bring the medicinal liquid preparation assist apparatus **11** anywhere and prepare medicinal liquids. Incidentally, the medicinal liquid preparation assist system may be configured such that the medicine bottle weight measurement unit **14**, the infusion bag weight measurement unit **15**, the cradle **16**, and the information presentation unit **17** are separated from the base **13**.

[0064] The following will describe the medical information database **12**. In the medicinal liquid preparation assist system **10**, medical information such as information about medicinal liquids, auditing information, and information about patients is sent and received between the medicinal liquid preparation assist apparatus **11** and the medical information database **12**. This configuration enables a variety of information to be retrieved from the medical information database **12** as needed and be stored in the storage unit **19**. Further, the auditing information stored in the storage unit **19** can be accumulated as medical information in the medical information database **12**. A variety of information is sent and received between the medicinal liquid preparation assist apparatus **11** and the medical information database **12** as described above, so that the capacity of the storage unit **19** in the base **13** can be reduced. Thus, the medicinal liquid preparation assist apparatus **11** can be further downsized.

[0065] The following will describe information to be displayed on the display **17a** of the information presentation unit **17**. The control unit **18** displays the full-size photographic images (actually photographed images) of the medicine bottles **20** each containing a medicinal liquid to be injected into the infusion bag **21** on the display **17a** of the information presentation unit **17** in order of mixing and preparing processes, in accordance with information about medicinal liquids stored in the storage unit **19**. Thus, the information about medicinal liquids contains data of the actually photographed images.

[0066] With actually photographed images displayed in order of mixing and preparing processes, an operator such as a nurse or a pharmacist can arrange the medical bottles **20** in order of mixing and preparing processes. Therefore, the operator can visually check the types of medicinal liquids (types of medicine bottles). Hence, errors in the setting and arrangement order of medicine bottles can be prevented, even when medicine bottles containing medicinal liquids with similar names have to be arranged. Furthermore, since medicine bottles can be arranged in order of mixing and preparing processes, errors in withdrawing order of medicinal liquids (mixing and preparing order of medicinal liquids) can be prevented.

[0067] The medicinal liquid preparation assist system 10 includes a reader 24 which reads prescription identification data (prescription ID) in order to retrieve information about medicinal liquids from the medical information database 12. Prescription ID read by the reader 24 is stored in the storage unit 19 by the control unit 18. The prescription ID stored in the storage unit 19 is sent to the medical information database 12 by the control unit 18. The medical information database 12 sends information about medicinal liquids and patients corresponding to the prescription ID received by the medical information database 12. The control unit 18 causes the information about medicinal liquids and patients from the medical information database 12 to be stored in the storage unit 19. For example, one-dimensional bar-codes or two-dimensional bar-codes can be used for prescription ID.

[0068] In the medicinal liquid preparation assist system 10, the reader 24 for reading prescription ID is disposed at the rear of the information presentation unit 17. The reader 24 is folder-shaped so as to hold a sheet of paper 25 with a prescription printed thereon (hereinafter, will be referred to as “a prescription”). Therefore, the reader 24 reads prescription ID printed on the prescription 25 inserted into the folder.

[0069] The provision of the reader 24 for reading prescription ID makes it easy to retrieve medical information from the medical information database 12. Further, the provision of the folder for the prescription 25 at the rear of the information presentation unit 17 can reduce a risk that the prescription 25 may be blurred with medicinal liquids and so on to make characters on the prescription 25 unreadable in preparing the medicinal liquids.

[0070] Incidentally, a reader for reading information about medicinal liquids and patients printed on the prescription 25 may be provided instead of the reader 24 for reading prescription ID, and the information read by the reader may be stored in the storage unit 19. Alternatively, an input unit for inputting prescription ID, information about medicinal liquids, and the like may be provided instead of the readers for reading prescription ID, information about medicinal liquids and the like, and the information inputted by the input unit may be stored in the storage unit 19.

[0071] The medicinal liquid preparation assist system 10 further includes a camera 26. The camera 26 is used for the authentication of operators. Specifically, the control unit 18 conducts authentication by comparing the image of an operator captured by the camera 26 with the image of the operator stored in the storage unit 19. In this way, only those who are registered in advance can be authenticated. The camera 26 can be also used to identify the medicine bottle 20 containing a medicinal liquid to be used. Specifically, the control unit 18 conducts authentication by comparing the image of the medicine bottle 20 captured by the camera 26 with the actually photographed image contained in the information about medicinal liquids. In this way, errors in the setting of medicine bottles can be prevented. The camera 26 can be also used to record images of medicinal liquid preparing processes.

[0072] Although not shown, reflective photosensors may be embedded into positions on the medicine bottle weight measurement unit 14 where medicine bottles are placed, and signals generated by the reflective photosensors may be transmitted to the control unit 18. Thus, even in the case where the multiple medicine bottles 20 which are the same in weight are placed on the medicine bottle mounting portion 14a, the control unit 18 can determine, based on the signals from the reflective photosensors, whether or not the medicine bottles

are picked up from the medicine bottle mounting portion 14a in the order of mixing and preparing processes and whether or not the medicine bottles 20 are returned to the original positions on the medicine bottle mounting portion 14a. Thus, errors in the selection of medicine bottles can be surely prevented.

[0073] Although not shown, the medicinal liquid preparation assist apparatus 11 includes light emitting diode (LED) display units provided in the vicinity of the medicine bottle weight measurement unit 14. The LED display units correspond to the positions on the medicine bottle weight measurement unit 14 where medicine bottles are placed. Light emission from the LED display units is controlled by the control unit 18. Specifically, the control unit 18 causes the LED display unit corresponding to the medicine bottle 20 to be suctioned to emit light. The light emission from the LED display unit can clearly show an operator the medicine bottle to be suctioned.

[0074] The following will describe the principal operation of the medicinal liquid preparation apparatus system 10.

[0075] First, an operator such as a nurse or a pharmacist inserts the prescription 25 into the reader 24 disposed at the rear of the information presentation unit 17. The prescription 25 is printed with information about patients and medicinal liquids to be administered to the patients, prescription ID, and so on. Upon insertion of the prescription 25 into the reader 24, the reader 24 reads the prescription ID on the prescription 25. The prescription ID read by the reader 24 is stored in the storage unit 19 by the control unit 18. The prescription ID stored in the storage unit 19 is transmitted to the medical information database 12 by the control unit 18. The medical information database 12 sends information about patients, medicinal liquids, and so on corresponding to the prescription ID received by the medical information database 12. The information about patients, medicinal liquids, and so on from the medical information database 12, is stored in the storage unit 19 by the control unit 18.

[0076] Thereafter, the control unit 18 causes instructions in accordance with steps of preparing medicinal liquids to be displayed on the display 17a of the information presentation unit 17, based on the information about patients, medicinal liquids, and so on stored in the storage unit 19. Therefore, an operator can prepare medicinal liquids by following the instructions displayed on the display 17a of the information presentation unit 17.

[0077] FIG. 3 shows an example of the instructions displayed on the display 17a of the information presentation unit 17. FIG. 3 shows an example of an image instructing an operator to mount the medicine bottles 20 on the medicine bottle mounting portion 14a and mount the infusion bag 21 on the infusion bag mounting portion 15a.

[0078] Specifically, a status display 17b indicating the present status of a preparation process is shown on the uppermost portion of the display 17a. An operator can easily confirm, from the status display 17b, which step in the preparation process is being carried out. Therefore, the operator can easily resume the preparation despite interruptions.

[0079] In addition, an instruction display 17c and a done button 17d are shown below the status display 17b. Contents on the instruction display 17c change according to steps in the preparation process. A patient record display 17e indicating the name and room of a patient is shown below the instruction display 17c and the done button 17d.

[0080] A medicinal liquid information display 17f indicating information about medicinal liquids to be injected into the infusion bag 21 is also shown below the patient record display 17e. The medicinal liquid information display 17f, for example, as shown in FIG. 3, indicates the names and amounts of medicinal liquids together with actually photographed images 20c of the medicine bottles 20 to be set, in order of mixing and preparing processes from left to right.

[0081] As described above, the actually photographed images 20c of the medicine bottles 20 containing medicinal liquids to be injected into the infusion bag 21 are displayed on the display 17a of the information presentation unit 17 in order of mixing and preparing processes. Thus, an operator can mount the medicine bottles 20 on the medicine bottle mounting portion 14a almost in such a way as to overlap the medicine bottles on the actually photographed images 20c. Hence, the operator can arrange the medicine bottles 20 containing medicinal liquids to be injected into the infusion bag 21 on the medicine bottle mounting portion 14a in order of mixing and preparing processes.

[0082] FIG. 3 shows a case in which the medicinal liquids to be injected into the infusion bag 21 are medicinal liquids A, B, and C. The following will describe, as an example, a case in which the medicinal liquids A, B, and C are mixed and prepared in this order.

[0083] When the medicine bottles 20 containing the medicinal liquids A, B, and C, respectively, are to be set on the medicine bottle mounting portion 14a, it is possible to assist in auditing checking of types of the medicine bottles (types of the medicinal liquids), the arrangement order of the medicinal bottles, and counting of the medicine bottles, based on changes in weight measured by the medicine bottle weight measurement unit 14.

[0084] FIG. 4 illustrates an example of changes in weight measured by the medicine bottle weight measurement unit 14 in such a case where the medicine bottles 20 containing the medicinal liquid A, B, and C, respectively, are mounted on the medicine bottle mounting portion 14a.

[0085] First, the medicine bottle 20 containing the medicinal liquid A (hereinafter, will be referred to as the medicinal bottle A) is mounted on the medicine bottle mounting portion 14a by an operator. At this initial stage, as shown in FIG. 4, weight W1 of the medicine bottle A is measured by the medicine bottle weight measurement unit 14. At this point, the control unit 18 calculates an increment $\Delta W1$ in weight from zero ($\Delta W1 = W1 - 0$). The control unit 18 also recognizes and stores the calculated increment $\Delta W1$ as the weight of the medicine bottle A in the storage unit 19. Further, the control unit 18 compares the recognized weight $\Delta W1$ of the medicine bottle A and the initial weight of the medicine bottle A (a predetermined value) stored beforehand in the storage unit 19, and then stores the result of the comparison in the storage unit 19. Thus, the calculated weight $\Delta W1$ of the medicinal bottle A and the result of the comparison are stored in the storage unit 19 as auditing information.

[0086] Data on the initial weight of the medicine bottles containing the medicinal liquids A, B, and C, respectively, are included in the information about medicinal liquids. The initial weight of the medicine bottles herein means the weight of the medicine bottles before opening in the case where the medicinal liquids have to be used up at a single time. In contrast, the initial weight of the medicine bottles means the weight thereof after the previous use in the case where the medicinal liquids can be used at multiple times. The weight of

the medicinal bottles after the previous use may be registered into the medical information database 12 in association with the identification data assigned to the respective medicine bottles.

[0087] Next, the medicine bottle 20 containing the medicinal liquid B (hereinafter, will be referred to as the medicinal bottle B) is mounted on the medicine bottle mounting portion 14a by the operator, and then, as shown in FIG. 4, total weight W2 of the medicine bottles A and B is measured by the medicine bottle weight measurement unit 14. At this point, the control unit 18 calculates an increment $\Delta W2$ in weight from the previous calculated weight W1 ($\Delta W2 = W2 - W1$). The control unit 18 also recognizes and stores the calculated increment $\Delta W2$ as the weight of the medicine bottle B in the storage unit 19. Further, the control unit 18 compares the recognized weight $\Delta W2$ of the medicine bottle B and the initial weight of the medicine bottle B (a predetermined value) stored beforehand in the storage unit 19, and stores the result of the comparison in the storage unit 19. Thus, the calculated weight $\Delta W2$ of the medicinal bottle B and the result of the comparison are stored in the storage unit 19 as auditing information.

[0088] Thereafter, the medicine bottle 20 containing the medicinal liquid C (hereinafter, will be referred to as the medicinal bottle C) is mounted on the medicine bottle mounting portion 14a by the operator, and then, as shown in FIG. 4, total weight W3 of the medicine bottles from A to C is measured by the medicine bottle weight measurement unit 14. At this point, the control unit 18 calculates an increment $\Delta W3$ in weight from the previous calculated weight W2 ($\Delta W3 = W3 - W2$). The control unit 18 also recognizes and stores the calculated increment $\Delta W3$ as the weight of the medicine bottle C in the storage unit 19. Further, the control unit 18 compares the recognized weight $\Delta W3$ of the medicine bottle C and the initial weight of the medicine bottle C (a predetermined value) stored beforehand in the storage unit 19, and stores the result of the comparison in the storage unit 19. Thus, the calculated weight $\Delta W3$ of the medicinal bottle C and the result of the comparison are stored in the storage unit 19 as auditing information.

[0089] As described above, the weight of the medicine bottles 20 on the medicine bottle mounting portion 14a is calculated based on the increments in weight measured by the medicine bottle weight measurement unit 14, so that checking of the types of the set medicine bottles (medicinal liquids) can be assisted.

[0090] The control unit 18 also produces setting error information when recognizing that the calculated weight of the medicine bottle 20 does not coincide with the initial weight of the medicine bottle (the predetermined value) stored beforehand in the storage unit 19. Such a noncoincidence means that the calculated weight does not coincide with the initial weight within the margin of error. The setting error information may be displayed on the display 17a of the information presentation unit 17. Alternatively, a device for sounding an alarm (not shown) corresponding to the setting error information produced by the control unit 18 may be provided on the medicinal liquid preparation assist system 10.

[0091] The above-described auditing in checking the types of medicine bottles (medicinal liquids) is performed in the order of mixing and preparing processes. Thus, auditing of whether or not the arrangement order of medicine bottles coincides with the order of mixing and preparing processes can be concurrently assisted.

[0092] The control unit 18 also counts the number of changes in weight measured by the medicine bottle weight measurement unit 14 when the medicine bottles 20 are to be set on the medicine bottle mounting portion 14a, and calculates, from the result of the counting, the number of the medicine bottles 20 mounted on the medicine bottle mounting portion 14a. The calculated number of the medicine bottles 20 is stored in the storage unit 19 by the control unit 18. The control unit 18 then compares the calculated number of the medicine bottles 20 with the number of medicine bottles (a predetermined value) stored beforehand in the storage unit 19, and stores the result of the comparison in the storage unit 19. Thus, the calculated number of the medicine bottles 20 and the result of the comparison are stored in the storage unit 19 as auditing information.

[0093] In the case where data on the number of medicine bottles is contained in the information about medicinal liquids, the contained data may be used. Alternatively, the control unit 18 may analyze the number of medicine bottles from the information about medicinal liquids and store the analyzed number in the storage unit 19. For example, the control unit 18 can analyze the number of medicine bottles from the number of the actually photographed images contained in the information about medicinal liquids.

[0094] Thus, the number of changes in weight measured by the medicine bottle weight measurement unit 14 is counted, so that the auditing in counting the number of medicine bottles can be assisted. [0073]

[0095] The control unit 18 also produces counting error information indicating a shortage of medicine bottles when recognizing that the calculated number of the medicine bottles 20 does not coincide with the number of medicine bottles (the predetermined value) stored beforehand in the storage unit 19. The counting error information may be displayed on the display 17a of the information presentation unit 17. Alternatively, a device for sounding an alarm (not shown) corresponding to the counting error information produced by the control unit 18 may be provided on the medicinal liquid preparation assist system 10.

[0096] As described above, the medicinal liquid preparation assist system 10 can assist in auditing whether or not an error occurs in the setting of medicine bottles (medicinal liquids).

[0097] In the present embodiment, the weight of the medicinal bottles 20 is measured. However, in the case where the weight of medicine bottle bodies can be confirmed from the information about medicinal liquids, the weight of medicinal liquids may be measured. Specifically, the control unit 18 calculates the weight of medicinal liquids, by recognizing the weight of the medicine bottles 20 based on the increments in weight measured by the medicine bottle weight measurement unit 14 and subtracting the weight of the medicine bottle bodies from the recognized weight. The calculated weight of medicinal liquids is stored in the storage unit 19 by the control unit 18. The control unit 18 then compares the calculated weight of medicinal liquids with the initial weight of medicinal liquids stored beforehand in the storage unit 19 and stores the comparison result in the storage unit 19. Also in this case, the medicinal liquid preparation assist system 10 can assist in auditing whether or not an error occurs in the setting of medicine bottles (medicinal liquids).

[0098] In the case where data on the initial weight of medicinal liquids is contained in the information about medicinal liquids, the contained data may be used. Alternatively,

the control unit 18 may analyze the initial weight of medicinal liquids from the information about medicinal liquids and store the analyzed initial weight in the storage unit 19. Specifically, the control unit 18 may obtain differences between the initial weight of medicine bottles and the weight of medicine bottle bodies to calculate the initial weight of medicinal liquids. The initial weight of medicinal liquids herein means the weight of medicinal liquids contained in medicine bottles before opening in the case where the medicinal liquids have to be used up at a single time. In contrast, the initial weight of medicinal liquids means the weight of medicinal liquids contained in medicine bottles after the previous use in the case where the medicinal liquids can be used at multiple times.

[0099] After setting the medicine bottles 20 containing medicinal liquids to be injected into the infusion bag 21 on the medicine bottle mounting portion 14a, an operator firstly picks up the medicine bottle 20 containing the medicinal liquid A and withdraws a predetermined amount of the medicinal liquid A from the medicine bottle 20 in the operator's hand into the syringe 23a. The operator then returns the medicine bottle 20, from which the medicinal liquid A has been withdrawn, to the original position of the medicine bottle mounting portion 14a. Next, the operator picks up the medicine bottle 20 containing the medicinal liquid B and withdraws a predetermined amount of the medicinal liquid B from the medicine bottle 20 in the operator's hand into the syringe 23a. The operator then returns the medicine bottle 20, from which the medicinal liquid B has been withdrawn, to the original position of the medicine bottle mounting portion 14a. Lastly, the operator picks up the medicine bottle 20 containing the medicinal liquid C and withdraws a predetermined amount of the medicinal liquid C from the medicine bottle 20 in the operator's hand into the syringe 23a. Further, the operator returns the medicine bottle 20, from which the medicinal liquid C has been withdrawn, to the original position of the medicine bottle mounting portion 14a. Incidentally, injection of medicinal liquids from the syringe 23a into the infusion bag 21 may be performed either after withdrawing a medicinal liquid from a single medicine bottle 20 into the syringe 23a or after withdrawing medicinal liquids from multiple medicine bottles 20 into the syringe 23a.

[0100] Thus, auditing in checking the types of medicine bottles (types of medicinal liquids) picked up, the order in which medicine bottles are picked up, and the number of times medicine bottles are picked up can be assisted based on weight measured by the medicine bottle weight measurement unit 14 when the medicine bottles 20 are picked up from the medicine bottle mounting portion 14a. Auditing in measuring the amounts of medicinal liquids withdrawn into the syringe 23a, checking the types of the withdrawn medicinal liquids, the mixing and preparing order of the medicinal liquids, and the number of times the medicine bottles are returned can also be assisted based on weight measured by the medicine bottle weight measurement unit 14 when the medicine bottles 20 are returned onto the medicine bottle mounting portion 14a.

[0101] First, auditing at the time of picking up medicine bottles from the medicine bottle mounting portion 14a will be described. FIG. 5 shows an example of changes in weight measured by the medicine bottle weight measurement unit 14 when the medicine bottles 20 containing the medicinal liquid A, B, and C, respectively, are picked up from the medicine bottle mounting portion 14a.

[0102] The total weight $W3$ of the medicine bottles from A to C is measured by the medicine bottle weight measurement unit 14 as shown in FIG. 5 at the initial stage where the medicine bottles 20 containing the medicinal liquid A, B, and C, respectively, are set. First, an operator picks up the medicine bottle A from the medicine bottle mounting portion 14a to withdraw the medicinal liquid A. As a result, as shown in FIG. 5, total weight $W4$ of the medicine bottles A and B is measured by the medicine bottle weight measurement unit 14. At this point, the control unit 18 calculates a decrement $\Delta W4$ in weight from the weight $W3$ at the initial stage ($\Delta W4 = W3 - W4$). Further, the control unit 18 recognizes and stores the calculated decrement $\Delta W4$ as the weight of the medicine bottle A in the storage unit 19. The control unit 18 then compares the recognized weight $\Delta W4$ of the medicine bottle A with the initial weight of the medicine bottle A (the predetermined value) stored beforehand in the storage unit 19, and stores the comparison result in the storage unit 19. Thus, the calculated weight $\Delta W4$ of the medicine bottle A and the comparison result are stored in the storage unit 19 as auditing information.

[0103] Data on the initial weight of the medicine bottles containing the medicinal liquids A, B, and C may be data on the initial weight contained in the information about medicinal liquids or the initial weight calculated when the medicine bottles 20 are set on the medicine bottle mounting portion 14a.

[0104] Next, after withdrawing the medicinal liquid A, the operator returns the medicine bottle 20, from which the medicinal liquid A has been withdrawn, to the original position of the medicine bottle mounting portion 14a. As a result, as shown in FIG. 5, weight $W5$ is measured by the medicine bottle weight measurement unit 14. The operator then picks up the medicine bottle B from the medicine bottle mounting portion 14a to withdraw the medicinal liquid B. As a result, as shown in FIG. 5, weight $W6$ is measured by the medicine bottle weight measurement unit 14. At this point, the control unit 18 calculates a decrement $\Delta W5$ in weight from the weight $W5$ measured when the medicine bottle A is returned ($\Delta W5 = W5 - W6$). The control unit 18 then recognizes and stores the calculated decrement $\Delta W5$ as the weight of the medicine bottle B in the storage unit 19. Further, the control unit 18 compares the recognized weight $\Delta W5$ of the medicine bottle B with the initial weight of the medicine bottle B (the predetermined value) stored beforehand in the storage unit 19, and stores the comparison result in the storage unit 19. Thus, the calculated weight $\Delta W5$ of the medicine bottle B and the comparison result are stored in the storage unit 19 as auditing information.

[0105] Next, after withdrawing the medicinal liquid B, the operator returns the medicine bottle 20, from which the medicinal liquid B has been withdrawn, to the original position of the medicine bottle mounting portion 14a. As a result, as shown in FIG. 5, weight $W7$ is measured by the medicine bottle weight measurement unit 14. The operator then picks up the medicine bottle C from the medicine bottle mounting portion 14a to withdraw the medicinal liquid C. As a result, as shown in FIG. 5, weight $W8$ is measured by the medicine bottle weight measurement unit 14. At this point, the control unit 18 calculates a decrement $\Delta W6$ in weight from the weight $W7$ measured when the medicine bottle B is returned ($\Delta W6 = W7 - W8$). The control unit 18 then recognizes and stores the calculated decrement $\Delta W6$ as the weight of the medicine bottle C in the storage unit 19. Further, the control

unit 18 compares the recognized weight $\Delta W6$ of the medicine bottle C with the initial weight of the medicine bottle C (the predetermined value) stored beforehand in the storage unit 19, and stores the comparison result in the storage unit 19. Thus, the calculated weight $\Delta W6$ of the medicine bottle C and the comparison result are stored in the storage unit 19 as auditing information.

[0106] As described above, based on the decrements in weight measured by the medicine bottle weight measurement unit 14, auditing in checking the types of medicine bottles (medicinal liquids) picked up from the medicine bottle mounting portion 14a can be assisted by calculating the weight of the medicine bottles 20 picked up from the medicine bottle mounting portion 14a.

[0107] The control unit 18 also produces pickup error information when recognizing that the calculated weight of the medicine bottle 20 does not coincide with the initial weight of the medicine bottle (the predetermined value) stored beforehand in the storage unit 19. Such a noncoincidence means that the calculated weight does not coincide with the initial weight within the margin of error. The pickup error information may be displayed on the display 17a of the information presentation unit 17. Alternatively, a device for sounding an alarm (not shown) corresponding to the pickup error information produced by the control unit 18 may also be provided on the medicinal liquid preparation assist system 10.

[0108] Since auditing in checking the types of medicine bottles (medicinal liquids), as described above, is performed in accordance with the mixing and preparing order of medicinal liquids, auditing of whether or not the pickup order of medicine bottles coincides with the mixing and preparing order of medicinal liquids can be concurrently assisted.

[0109] The control unit 18 also counts the number of changes in weight measured by the medicine bottle weight measurement unit 14 when the medicinal liquids are withdrawn from the medicine bottles 20 containing the medicinal liquids A, B, and C, respectively, and based on the counting result, calculates the number of the medicine bottles 20 picked up from the medicine bottle mounting portion 14a. The calculated number of the medicine bottles 20 is stored in the storage unit 19 by the control unit 18. The control unit 18 then compares the calculated number of the medicine bottles 20 with the number of medicine bottles (the predetermined value) stored beforehand in the storage unit 19, and determines whether or not the medicine bottles 20 on the medicine bottle mounting portion 14a have been all picked up.

[0110] Data on the number of medicine bottles may be the number of medicine bottles contained in the information about medicinal liquids, the number of medicine bottles analyzed by the control unit 18 from the information about medicinal liquids, or the number of medicine bottles calculated when the medicine bottles 20 are set on the medicine bottle mounting portion 14a.

[0111] As described above, the number, of changes in weight measured by the medicine bottle weight measurement unit 14 is counted, so that auditing of whether or not the medicinal liquids were withdrawn from all the medicine bottles 20 on the medicine bottle mounting portion 14a can be assisted.

[0112] Thus, the medicinal liquid preparation assist system 10 can assist in auditing whether or not an error occurs in the picking up of medicine bottles (medicinal liquids).

[0113] In the above description, the weight of the medicine bottles is measured. However, the weight of medicinal liquids

may be calculated when data on the weight of medicine bottle bodies can be confirmed from the information about medicinal liquids. Specifically, the control unit 18 calculates the weight of medicinal liquids, by recognizing the weight of the medicine bottles 20 based on the decrements in weight measured by the medicine bottle weight measurement unit 14 and subtracting the weight of the medicine bottle bodies from the recognized weight. The calculated weight of medicinal liquids is stored in the storage unit 19 by the control unit 18. The control unit 18 then compares the calculated weight of medicinal liquids with the initial weight of medicinal liquids stored beforehand in the storage unit 19 and stores the comparison result in the storage unit 19. Also in this case, the medicinal liquid preparation assist system 10 can assist in auditing whether or not an error occurs in the picking up of medicine bottles (medicinal liquids).

[0114] The following will describe auditing when the medicine bottles 20 are returned to the medicine bottle mounting portion 14a. FIG. 6 shows an example of changes in weight measured by the medicine bottle weight measurement unit 14 when the medicine bottles 20, from which the medicinal liquids A, B, and C have been withdrawn, are returned to the medicine bottle mounting portion 14a.

[0115] At the initial stage in which the medicine bottles, 20 containing the medicinal liquids A, B, and C, respectively, are set, as shown in FIG. 6, the total weight W3 of the medicine bottles A to C is measured by the medicine bottle weight measurement unit 14. First, an operator picks up the medicine bottle A from the medicine bottle mounting portion 14a to withdraw the medicinal liquid A. Next, after withdrawing the medicinal liquid A, the operator returns the medicine bottle 20, from which the medicinal liquid A has been withdrawn, to the original position of the medicine bottle mounting portion 14a. As a result, as shown in FIG. 6, the weight W5 is measured by the medicine bottle weight measurement unit 14. At this point, the control unit 18 calculates a decrement $\Delta W7$ in weight from the weight W3 at the initial stage ($\Delta W7=W3-W5$). The control unit 18 then recognizes and stores the calculated decrement $\Delta W7$ as the weight of the withdrawn medicinal liquid A in the storage unit 19. Further, the control unit 18 compares the recognized weight $\Delta W7$ of the withdrawn medicinal liquid A with the weight of the withdrawn medicinal liquid A (a predetermined value) stored beforehand in the storage unit 19, and stores the comparison result in the storage unit 19. Thus, the calculated weight $\Delta W7$ of the withdrawn medicinal liquid A and the comparison result are stored in the storage unit 19 as auditing information.

[0116] In the case where data on the weight of withdrawn medicinal liquids is contained in the information about medicinal liquids, the contained data may be used. Alternatively, the control unit 18 may calculate the weight of withdrawn medicinal liquids from the amounts of medicinal liquids contained in the information about medicinal liquids, and store the calculated weight of withdrawn medicinal liquids in the storage unit 19. The control unit 18 may calculate the amounts of withdrawn medicinal liquids from the calculated weight of withdrawn medicinal liquids and compare the calculated amounts with data on the amounts of medicinal liquids contained in the information about medicinal liquids.

[0117] Next, the operator picks up the medicine bottle B to withdraw the medicinal liquid B from the medicine bottle mounting portion 14a. Further, after withdrawing the medicinal liquid B, the operator returns the suctioned medicine bottle 20 to the original position of the medicine bottle mount-

ing portion 14a. As a result, as shown in FIG. 6, the weight W7 is measured by the medicine bottle weight measurement unit 14. At this point, the control unit 18 calculates a decrement $\Delta W8$ in weight from the weight W5 measured when the medicine bottle A is returned ($\Delta W8=W5-W7$). The control unit 18 then recognizes and stores the calculated decrement $\Delta W8$ as the weight of the withdrawn medicinal liquid B in the storage unit 19. Further, the control unit 18 compares the recognized weight $\Delta W8$ of the withdrawn medicinal liquid B with the weight of the withdrawn medicinal liquid B (a predetermined value) stored beforehand in the storage unit 19, and stores the comparison result in the storage unit 19. Thus, the calculated weight $\Delta W8$ of the withdrawn medicinal liquid B and the comparison result are stored in the storage unit 19 as auditing information.

[0118] Next, the operator picks up the medicine bottle C from the medicine bottle mounting portion 14a to withdraw the medicinal liquid C. Further, after withdrawing the medicinal liquid C, the operator returns the medicine bottle 20 to the original position of the medicine bottle mounting portion 14a. As a result, as shown in FIG. 6, weight W9 is measured by the medicine bottle weight measurement unit 14. At this time, the control unit 18 calculates a decrement $\Delta W9$ in weight from the weight W7 measured when the medicine bottle B is returned ($\Delta W9=W7-W9$). The control unit 18 then recognizes and stores the calculated decrement $\Delta W9$ as the weight of the withdrawn medicinal liquid C in the storage unit 19. Further, the control unit 18 compares the recognized weight $\Delta W9$ of the withdrawn medicinal liquid C with the weight of the withdrawn medicinal liquid C (a predetermined value) stored beforehand in the storage unit 19, and stores the comparison result in the storage unit 19. Thus, the calculated weight $\Delta W9$ of the withdrawn medicinal liquid C and the comparison result are stored in the storage unit 19 as auditing information.

[0119] As described above, the weight or amounts of the withdrawn medicinal liquids are calculated based on the decrements in weight measured by the medicine bottle weight measurement unit 14, so that auditing in measuring the amounts of medicinal liquids withdrawn into the syringe 23a and checking the types of the withdrawn medicinal liquids can be assisted.

[0120] The control unit 18 also produces withdrawal error information when recognizing that the calculated weight or amounts of withdrawn medicinal liquids do not coincide with data on the weight or amounts of the withdrawn medicinal liquids (the predetermined values) stored beforehand in the storage unit 19. Such a noncoincidence means that the calculated weight or amounts do not coincide with the weight or amounts stored beforehand within the margin of error. The withdrawal error information indicates at least one of; errors in the amounts of withdrawn medicinal liquids; errors in the types of withdrawn medicinal liquids; and spilling of medicinal liquids. The withdrawal error information may be displayed on the display 17a of the information presentation unit 17. Alternatively, a device for sounding an alarm (not shown) corresponding to the withdrawal error information produced by the control unit 18 may also be provided on the medicinal liquid preparation assist system 10.

[0121] The following will describe another method for assisting in auditing checking of the types of withdrawn medicinal liquids using the medicinal liquid A as an example with reference to FIG. 5. The auditing in checking the medi-

nal liquid A, which will be described below, can be applied to the medicinal liquids B and C, and an explanation thereof is omitted.

[0122] As described above, the weight W4 is measured by the medicine bottle weight measurement unit 14 when the medicine bottle 20 containing the medicinal liquid A is picked up from the medicine bottle mounting portion 14a, and the weight W5 is measured by the medicine bottle weight measurement unit 14 when the medicine bottle 20, from which the medicinal liquid A has been withdrawn, is returned to the medicine bottle mounting portion 14a. At this time, the control unit 18 calculates an increment $\Delta W10$ in weight from the weight W4 ($\Delta W10 = W5 - W4$). The control unit 18 then recognizes the calculated increment $\Delta W10$ in weight as the weight of the medicine bottle 20 from which the medicinal liquid A has been withdrawn and stores the recognized weight $\Delta W10$ in the storage unit 19. Further, the control unit 18 compares the recognized weight $\Delta W10$ of the medicine bottle 20 after withdrawal with data on weight (a predetermined value) of the medicine bottle, from which a predetermined amount of the medicinal liquid A has been withdrawn, stored beforehand in the storage unit 19, and stores the comparison result in the storage unit 19. Thus the calculated weight $\Delta W10$ of the medicine bottle A after withdrawal and the comparison result are stored in the storage unit 19 as auditing information.

[0123] In the case where data on the weight of medicine bottle, from which the predetermined amount of medicinal liquid has been withdrawn, is contained in the information about medicinal liquids, the contained data may be used. Alternatively, the control unit 18 may analyze the weight of medicine bottle, from which the predetermined amount of the medicinal liquid has been withdrawn, from the information about medicinal liquids and store the analyzed weight in the storage unit 19. The weight of the medicine bottle, from which the predetermined amount of the medicinal liquid has been withdrawn, can be obtained by, for example, calculating a difference between the initial weight of the medicine bottle and the weight of the withdrawn medicinal liquid.

[0124] As described above, auditing in checking the types of withdrawn medicinal liquids can be assisted by calculating the weight of the medicine bottles 20, from which the medicinal liquids have been withdrawn, based on the increments in weight measured by the medicine bottle weight measurement unit 14.

[0125] The control unit 18 also produces withdrawal error information when recognizing that the calculated weight of the medicine bottle 20 after withdrawal does not coincide with the weight of the medicine bottle after withdrawal stored beforehand in the storage unit 19. Such a noncoincidence means that the calculated weight does not coincide with the weight stored beforehand within the margin of error. The withdrawal error information indicates at least one of; errors in the amounts of withdrawn medicinal liquids; errors in the types of withdrawn medicinal liquids; and spilling of medicinal liquids. The withdrawal error information may be displayed on the display 17a of the information presentation unit 17. Alternatively, a device for sounding an alarm (not shown) corresponding to the withdrawal error information produced by the control unit 18 may also be provided on the medicinal liquid preparation assist system 10.

[0126] Since auditing in checking the types of medicine bottles (medicinal liquids), as described above, is performed in accordance with the mixing and preparing order of medi-

nal liquids, auditing of whether or not the mixing and preparing order of medicinal liquids is correct can be concurrently assisted.

[0127] Incidentally, the control unit 18 counts the number of changes in weight measured by the medicine bottle weight measurement unit 14 when the medicinal liquids are withdrawn from the medicine bottles containing the medicinal liquids A, B, and C, respectively, and based on the counting result, calculates the number of the medicine bottles 20 returned onto the medicine bottle mounting portion 14a. The control unit 18 stores the calculated number of the medicine bottles 20 in the storage unit 19. The control unit 18 then determines whether or not the medicine bottles are all returned onto the medicine bottle mounting portion 14a by comparing the calculated number of the medicine bottles 20 and data on the number of the medicine bottles (the predetermined value) stored beforehand in the storage unit 19.

[0128] Thus, auditing of whether or not the medicinal liquids are withdrawn from all the medicine bottles mounted on the medicine bottle mounting portion 14a can be assisted by counting the number of changes in the weight measured by the medicine bottle weight measurement unit 14.

[0129] As described above, the medicinal liquid preparation assist system 10 can assist in auditing of whether or not an error occurs in the amounts of withdrawn medicinal liquids and so on.

[0130] The following will describe auditing methods in accordance with changes in weight measured by the infusion bag weight measurement unit 15, using, as an example, the case where, every time the medicinal liquid is withdrawn from the medicine bottle 20, the withdrawn medicinal liquid is injected into the infusion bag 21.

[0131] When the medicinal liquid is injected from the syringe 23a into the infusion bag 21 on the infusion bag mounting unit 15a, weight measured by the infusion bag weight measurement unit 15 increases in proportion to the injected amount. The control unit 18 calculates the weight of the medicinal liquid injected into the infusion bag 21 based on an increment in weight measured by the infusion bag weight measurement unit 15. The calculated weight of the injected medicinal liquid is stored in the storage unit 19 by the control unit 18. The control unit 18 then compares the calculated weight of the injected medicinal liquid with data on the weight of the injected medicinal liquid is predetermined value) stored beforehand in the storage unit 19, and stores the comparison result in the storage unit 19. Thus, the calculated weight of the injected medicinal liquid and the comparison result are stored in the storage unit 19 as auditing information.

[0132] In the case where data on the weight of the injected medicinal liquid is contained in the information about medicinal liquids, the contained data may be used. Alternatively, the control unit 18 may calculate the weight of the injected medicinal liquid from the amount of the medicinal liquid contained in the information about medicinal liquids, and store the calculated weight of the injected medicinal liquid in the storage unit 19. The control unit 18 may calculate the amount of the injected medicinal liquid from the calculated weight of the injected medicinal liquid and compare the calculated amount with data on the amount of the medicinal liquid contained in the information about medicinal liquids. Alternatively, the amounts or weight of the withdrawn medicinal liquids calculated when the medicinal liquids are

withdrawn from the medicine bottles **20** into the syringe **23a** may be used as data on the amounts or weight of injected medicinal liquids.

[0133] As described above, auditing in measuring the amounts of medicinal liquids injected into the infusion bag **21** and checking the types of the medicinal liquids can be assisted by calculating the weight or the amounts of the injected medicinal liquids based on increments in weight measured by the infusion bag weight measurement unit **15**.

[0134] The control unit **18** also produces injection error information when recognizing that the calculated weight or amount of the injected medicinal liquid does not coincide with data on the weight or amount of the injected medicinal liquid (a predetermined value) stored beforehand in the storage unit **19**. Such a noncoincidence means that the calculated weight or amount does not coincide with the weight or amount stored beforehand within the margin of error. The injection error information indicates at least one of; errors in the amounts of injected medicinal liquids; errors in the types of injected medicinal liquids; remaining of medicinal liquids in the syringe **23a**; and spilling of medicinal liquids. The injection error information may be displayed on the display **17a** of the information presentation unit **17**. Alternatively, a device for sounding an alarm (not shown) corresponding to the injection error information produced by the control unit **18** may also be provided on the medicinal liquid preparation assist system **10**.

[0135] Since auditing in measuring the weight of medicinal liquids injected into the infusion bag, as described above, is performed in accordance with the mixing and preparing order of medicinal liquids, auditing of whether or not the mixing and preparing order of medicinal liquids is correct can be concurrently assisted.

[0136] The control unit **18** also counts the number of changes in weight measured by the infusion bag weight measurement unit **15**, and based on the counting result, calculates the number of times the medicinal liquid is injected into the infusion bag **21**. The calculated number of times is stored in the storage unit **19** by the control unit **18**. The control unit **18** then compares the calculated number of times the medicinal liquid is injected with data on the number of medicine bottles (the predetermined value) stored beforehand in the storage unit **19**, and stores the comparison result in the storage unit **19**. Thus the calculated number of times the medicinal liquid is injected and the comparison result are stored in the storage unit **19** as auditing information.

[0137] The data on the number of medicine bottles may be data on the number of medicinal liquids contained in the information about medicinal liquids. Alternatively, the data on the number of medicinal liquids analyzed from the information about medicinal liquids by the control unit **18** may be used. Alternatively, the data on the number of medicinal liquids counted when the medicinal liquids are withdrawn from the medicine bottles **20** on the medicine bottle mounting portion **14a** may be used. Alternatively, the data on the number of medicinal liquids counted when the medicinal liquids are withdrawn from the medicine bottles **20** on the medicine bottle mounting portion **14a** may be used.

[0138] As described above, auditing of the number of times the medicinal liquid is injected (auditing in counting the number of medicinal liquids) can be assisted by counting the number of changes in weight measured by the infusion bag weight measurement unit **15**.

[0139] The control unit **18** also produces counting error information indicating a shortage in the number of times the medicinal liquid is injected when recognizing that the calculated number of times the medicinal liquid is injected does not coincide with the data on the number of medicine bottles (the predetermined value) stored beforehand in the storage unit **19**. The counting error information may be displayed on the display **17a** of the information presentation unit **17**. Alternatively, a device for sounding an alarm (not shown) corresponding to the counting error information produced by the control unit **18** may be provided on the medicinal liquid preparation assist system **10**.

[0140] As described above; the medicinal liquid preparation assist system **10** can assist in auditing of whether or not an error occurs in the amount of the injected medicinal liquid and so on.

[0141] In the above description, every time the medicinal liquid is withdrawn from the medicine bottle **20**, the withdrawn medicinal liquid is injected into the infusion bag **21**. Even in the case where after the medicinal liquids are withdrawn from the multiple medicine bottles into the syringe **23a**, the medicinal liquids withdrawn multiple times are injected from the syringe **23a** into the infusion bag **21** at a time, auditing in measuring the amounts of the injected medicinal liquids, checking the types of the injected medicinal liquids, and the mixing and preparing order of the medicinal liquids can be assisted. In the auditing processes, the total amounts or total weight of all the medicinal liquids withdrawn into the syringe **23a** multiple times is used. Further, since the number of times the medicinal liquid is injected does not coincide with the number of the medicine bottles in this case, data on the number of times the medicinal liquid is injected has to be stored beforehand in the storage unit **19** to assist in auditing of the number of times the medicinal liquid is injected. In the case where the data on the number of times the medicinal liquid is injected is contained in the information about medicinal liquids, the contained data may be used. Alternatively, the control unit **18** may analyze the number of times the medicinal liquid is injected from the information about medicinal liquids, and store the analyzed data on the number of times the medicinal liquid is injected in the storage unit **19**. For example, the control unit **18** can analyze the number of times the medicinal liquid is injected from the data on the mixing and preparing processes of medicinal liquids contained in the information about medicinal liquids.

[0142] The following will describe auditing processes in accordance with weight measured by the cradle **16**, using, as an example, the case where every time the medicinal liquid is withdrawn from the medicine bottle **20**, the withdrawn medicinal liquid is injected into the infusion bag **21**.

[0143] While the medicinal liquid is withdrawn from the medicine bottle **20** or injected into the infusion bag **21**, the syringe driving device **23** is not held by the cradle **16** but is held in an operator's hand.

[0144] When an operator places the syringe driving device **23** on the cradle **16** after withdrawing the medicinal liquid into the syringe **23a** but prior to injecting the medicinal liquid into the infusion bag **21**, the weight of the syringe driving device **23** increases from the initial weight in accordance with the amount of the medicinal liquid withdrawn into the syringe **23a**. The initial weight of the syringe driving device **23** is weight in a state that the syringe **23a** is empty. The control unit **18** calculates the weight of the medicinal liquid withdrawn into the syringe **23a** based on the weight measured by

the cradle 16. The calculated withdrawn weight is stored in the storage unit 19 by the control unit 18. The control unit 18 then compares the calculated weight of the withdrawn medicinal liquid with data on the weight of the withdrawn medicinal liquid stored beforehand in the storage unit 19, and stores the comparison result in the storage unit 19. Thus, the calculated weight of the withdrawn medicinal liquid and the comparison result are stored in the storage unit 19 as auditing information.

[0145] When data on the weight of the withdrawn medicinal liquid is contained in the information about medicinal liquids, the contained data may be used. Alternatively, the control unit 18 may calculate the weight of the withdrawn medicinal liquid from data on the amount of the medicinal liquid contained in the information about medicinal liquids and store the data on the calculated weight of the medicinal liquid in the storage unit 19. Incidentally, the control unit 18 may calculate the amount of the withdrawn medicinal liquid from the calculated weight of the withdrawn medicinal liquid and may compare the calculated withdrawn amount with data on the amount of the medicinal liquid contained in the information about medicinal liquids. Alternatively, the amount or weight of the withdrawn medicinal liquid calculated based on changes in weight measured by the medicine bottle weight measurement unit 14 may be used as data on the amount or weight of the withdrawn medicinal liquid.

[0146] As described above, auditing in measuring the amount of the withdrawn medicinal liquid and checking the type of the medicinal liquid withdrawn into the syringe 23a may be assisted by calculating the weight or amount of the withdrawn medicinal liquid based on the weight measured by the cradle 16.

[0147] The control unit 18 also produces withdrawal error information when recognizing that the calculated weight or amount of the withdrawn medicinal liquid does not coincide with data on the weight or amount of the withdrawn medicinal liquid (a predetermined value) stored beforehand in the storage unit 19. Such a noncoincidence means that the calculated weight or amount does not coincide with the weight or amount stored beforehand within the margin of error. The withdrawal error information indicates at least one of; errors in the amount of the withdrawn medicinal liquid; an error in the type of the withdrawn medicinal liquid; and spilling of the medicinal liquid. The withdrawal error information may be displayed on the display 17a of the information presentation unit 17. Alternatively, a device for sounding an alarm (not shown) corresponding to the withdrawal error information produced by the control unit 18 may also be provided on the medicinal liquid preparation assist system 10.

[0148] Since auditing in measuring the amounts of the medicinal liquids withdrawn into the syringe 23a, as described above, is performed in accordance with the mixing and preparing order of medicinal liquids, auditing of whether or not the withdrawing order of medicinal liquids is correct can be concurrently assisted.

[0149] The control unit 18 also counts the number of times the weight is measured by the cradle 16, and based on the counting result, calculates the number of times the medicinal liquid is injected into the infusion bag from the syringe 23a. The calculated number of times is stored in the storage unit 19 by the control unit 18. The control unit 18 then compares the calculated number of times the medicinal liquid is injected with data on the number of the medicine bottles (the predetermined value) stored in the storage unit 19 beforehand, and

stores the comparison result in the storage unit 19. Thus, the calculated number of times the medicinal liquid is injected and the comparison result are stored in the storage unit 19 as auditing information.

[0150] As described above, auditing of the number of times the medicinal liquid is injected (auditing in counting the number of medicinal liquids) can be assisted by counting the number of times the weight is measured by the cradle 16.

[0151] The control unit 18 also produces counting error information indicating a shortage in the number of times the medicinal liquid is injected when recognizing that the calculated number of times the medicinal liquid is injected does not coincide with data on the number of medicine bottles stored beforehand in the storage unit 19. The counting error information may be displayed on the display 17a of the information presentation unit 17. Alternatively, a device for sounding an alarm (not shown) corresponding to the counting error information produced by the control unit 18 may be provided on the medicinal liquid preparation assist system 10.

[0152] As describe above, the medicinal liquid preparation assist system 10 can assist in auditing whether or not errors occur in the amounts of withdrawn medicinal liquids and so forth.

[0153] In the above description, every time the medicinal liquid is withdrawn from the medicine bottle 20, the withdrawn medicinal liquid is injected into the infusion bag 21. Even in the case where after the medicinal liquids are withdrawn from the multiple medicinal bottles into the syringe 23a, the weight of the syringe driving device 23 is measured, auditing in measuring the amounts of the withdrawn medicinal liquids, checking the types of the withdrawn medicinal liquids, and the mixing and preparing order of the medicinal liquids can be assisted. In the auditing processes, the total amounts or total weight of all the medicinal liquids withdrawn into the syringe 23a multiple times is used. In auditing the number of times the medicinal liquid is injected, the data on the number of times the medicinal liquid is injected which is stored in the storage unit is used.

[0154] The following will describe auditing of whether or not the medicinal liquid remains in the syringe 23a after the medicinal liquid is injected into the infusion bag 21. When an operator places the syringe driving device 23 on the cradle 16 after injecting the medicinal liquid into the infusion bag 21, the control unit 18 determines whether or not the weight measured by the cradle 16 coincides with the initial weight of the syringe driving device 23. The control unit 18 generates the determination result as auditing information.

[0155] Hence, auditing of whether or not all the medicinal liquids withdrawn into the syringe 23a are injected into the infusion bag 21 can be assisted based on the weight measured by the cradle 16.

[0156] The control unit 18 also produces residual error information when recognizing that the medicinal liquid remains in the syringe 23a. The residual error information may be displayed on the display 17a of the information presentation unit 17. Alternatively, a device for sounding an alarm (not shown) corresponding to the residual error information produced by the control unit 18 may be provided on the medicinal liquid preparation assist system 10.

[0157] As described above, according to the medicinal liquid preparation assist system 10 of the embodiment, errors in the selection of medicine bottles and the amounts of withdrawn medicinal liquids, and so forth can be surely prevented. Therefore, according to the medicinal liquid preparation

assist system 10, operation errors (preparation errors) in the mixing and preparing order of medicinal liquids and measuring the amounts of medicinal liquids, and so forth can be effectively prevented, and safe and accurate preparation of medicinal liquids can be accomplished.

[0158] The medicinal liquid preparation assist system 10 also produces auditing information automatically and reliably. Therefore, the efficiency of preparing medicinal liquids can be increased, according to the medicinal liquid preparation assist system 10.

[0159] Further, according to the medicinal liquid preparation assist system 10, an operator can be immediately notified of the occurrence of operation errors in selecting medicine bottles and measuring the amounts of medicinal liquids. Therefore, according to the medicinal liquid preparation assist system 10, medicinal liquids (medicine bottles) and infusion bags can be prevented from being wasted, and the cost of preparing medicinal liquids can be reduced. For example, when an error in measuring the amount of the medicinal liquid first withdrawn into the syringe is detected before the medicinal liquid is injected into the infusion bag, the medicine bottles, from which the medicinal liquids are to be subsequently withdrawn, and the infusion bag can be prevented from being wasted.

[0160] The auditing processes are performed by the medicinal liquid preparation assist system 10, based on not only the weight measured by the medicine bottle weight measurement unit 14 but also the weight measured by the infusion bag weight measurement unit 15 and the weight measured by cradle 16. This configuration makes it possible to doubly or triply prevent operation errors in the selection of medicine bottles, the amounts of medicinal liquids, and so forth. Hence, according to the medicinal liquid preparation assist system 10, safer and more accurate preparation of medicinal liquids can be achieved.

[0161] The medicinal liquid preparation assist system 10 can quantitatively grasp from which of the medicine bottles the medicinal liquid is being withdrawn at the moment, since the increment in weight is calculated when the medicine bottle 20, from which the medicinal liquid has been withdrawn, is returned onto the medicine bottle mounting portion 14a, in addition to the decrement in weight when the medicine bottle 20 is picked up from the medicine bottle mounting portion 14a. In other words, the medicinal liquid preparation assist system 10 can automatically determine which step of the preparing process of medicinal liquids is being presently carried out. Thus, the control unit 18 can display information about the present step on the display 17a of the information presentation unit 17. Accordingly, an operator can easily resume preparing medicinal liquids by referring to the display 17a despite interruptions. That is, errors in preparing medicinal liquids due to interruptions can be effectively prevented.

[0162] The following will describe a method for assisting medicinal liquid preparation using the above-described medicinal liquid preparation assist system 10. FIG. 7 shows a flow chart of the method for assisting medicinal liquid preparation according to the present embodiment.

[0163] As shown in FIG. 7, the method for assisting medicinal liquid preparation includes: step S1 of reading prescription ID; step S2 of first display; step 3 of selecting medicine bottles; step S4 of withdrawing medicinal liquids; step S5 of injecting medicinal liquids; and step S6 of second display.

[0164] In step S1, the reader 24 reads prescription ID printed on the prescription 25, the control unit 18 sends the

prescription ID to the medical information database 12, the medical information database 12 sends information about a patient and medicinal liquids in accordance with the received prescription ID, the control unit 18 stores the received information about a patient and medicinal liquids in the storage unit 19.

[0165] In step S2, the control unit 18 reads out data such as the types and amounts of medicinal liquids, actually photographed images of medicine bottles, and so forth included in the information about medicinal liquids from the storage unit 19, and display the data on the display 17a of the information presentation unit 17.

[0166] In step S3, an operator such as a nurse or a pharmacist sets the medicine bottles 20 containing medicinal liquids to be injected into the infusion bag 21 on the medicine bottle mounting portion 14a. At this point, the medicine bottle weight measurement unit 14 measures the total weight of all the medicine bottles on the medicine bottle mounting portion 14a (a medicine bottle weight measurement step). Then, the control unit 18 produces auditing information which indicates the auditing result of setting the medicine bottles based on changes in weight measured by the medicine bottle weight measurement unit 14, and stores the produced auditing information in the storage unit 19 (a first auditing information producing step).

[0167] In step S4, the operator picks up the medicine bottle 20 from the medicine bottle mounting portion 14a. The operator then withdraws the medicinal liquid from the picked up medicine bottle into the syringe 23a fitted to the syringe driving device 23 by operating the syringe driving device 23, and returns the medicine bottle 20, from which the medicinal liquid has been withdrawn, to the medicine bottle mounting portion 14a. At this point, the medicine bottle weight measurement unit 14 measures the weight of all the medicine bottles on the medicine bottle mounting portion 14a (the medicine bottle weight measurement step). Further, the control unit 18 produces auditing information which indicates the auditing results of picking up the medicine bottles and withdrawing the medicinal liquids based on the changes in weight measured by the medicine bottle weight measurement unit 14, and stores the produced auditing information in the storage unit 19 (the first auditing information producing step).

[0168] Specifically, in step S4, whether or not the medicine bottles are correctly picked up in the predetermined mixing and preparing order of medicinal liquids is audited based on the changes in weight measured by the medicine bottle weight measurement unit 14, the changes being caused by picking up the medicine bottles 20 from the medicine bottle mounting portion 14a. Further, whether or not the predetermined amounts of medicinal liquids are withdrawn from the picked up medicine bottles is audited based on the changes in weight measured by the medicine bottle weight measurement unit 14, the changes being caused by returning the medicine bottles 20 to the medicine bottle mounting portion 14a.

[0169] In step S5, the operator injects the medicinal liquid from the syringe 23a into the infusion bag 21 by operating the syringe driving device 23. At this point, the infusion bag weight measurement unit 15 measures the weight of the infusion bag 21 placed on the infusion bag mounting portion 15a (a infusion bag weight measurement step). Further, the control unit 18 produces auditing information which indicates the auditing results of injecting the medicinal liquids based on the changes in weight measured by the infusion bag weight mea-

surement unit 15, and stores the produced auditing information in the storage unit 19 (a second auditing information producing step).

[0170] In step S6, the control unit 18 reads out the auditing information from the storage unit 19 and displays the auditing information on the display 17a of the information presentation unit 17.

[0171] An input unit capable of inputting the prescription ID may be provided instead of the reader 24 on the medicinal liquid preparation assist apparatus 11 so as to send the prescription ID inputted in step S1 to the medical information database 12.

[0172] According to the above-described method, auditing in counting medicine bottles, checking the types of medicine bottles (the types of medicinal liquids), the mixing and preparing order of medicinal liquids, measuring the amounts of medicinal liquids, and so on can be assisted based on the changes in weight measured by the medicine bottle weight measurement unit 14 and the infusion bag weight measurement unit 15. The auditing processes can prevent errors in setting medicine bottles, selecting medicine bottles at the time of preparing medicinal liquids, the amounts of medicinal liquids, and so forth. Hence, safe and accurate preparation of medicinal liquids can be achieved.

[0173] The following will describe a specific example of the method for assisting medicinal liquid preparation according to the present embodiment. FIG. 8 shows the former half of a flowchart of the specific example of the method for assisting medicinal liquid preparation according to the present embodiment, and FIG. 9 shows the latter half of the flowchart. FIGS. 10 to 22 each show an example of images displayed on the display 17a of the information presentation unit 17 in accordance with the flowcharts shown in FIGS. 8 and 9. As described before, the images displayed on the display 17a of the information presentation unit 17 are controlled by the control unit 18. In FIGS. 8 and 9, the medicinal liquids to be injected into the infusion bag 21 are all injected into the infusion bag 21 at a time. Further, in FIGS. 8 and 9, the medicinal liquids to be injected into the infusion bag 21 are the medicinal liquids A, B, and C which will be mixed and prepared in this order.

[0174] First, in step S10, as shown in FIG. 10, an image instructing an operator to insert the prescription 25 into the reader 24 is displayed on the display 17a of the information presentation unit 17.

[0175] An operator such as a nurse or a pharmacist inserts the prescription 25 into the reader 24 according to the instruction displayed on the display 17a, and the reader 24 reads the prescription ID printed on the prescription 25 (step S11), followed by step S12.

[0176] In step S12, the control unit 18 sends the prescription ID read by the reader 24 to the medical information database 12. The medical information database 12 sends the information about medicinal liquids and a patient corresponding to the received prescription ID. The control unit 18 stores the information from the medical information database 12 in the storage unit 19. In the meantime, as shown in FIG. 11, an image indicating that the information about medicinal liquids and a patient are being retrieved from the medical information database 12 is displayed on the display 17a of the information presentation unit 17. The information about medicinal liquids and a patient is stored in the storage unit 19, followed by step S13.

[0177] In step S13, as shown in FIG. 12, an image instructing the operator to mount the medicine bottles 20 on the medicine bottle mounting portion 14a and the infusion bag 21 on the infusion bag mounting portion 15a is displayed on the display 17a of the information presentation unit 17, based on the information about medicinal liquids and a patient stored in the storage unit 19.

[0178] In this embodiment, 1 V (1 vial) of the medicinal liquid A, 1 A (1 ampule) of the medicinal liquid B, and 1 V (1 vial) of the medicinal liquid C are mixed and prepared. The medicinal liquid information display 17f indicates the names and amounts of the medicinal liquids A, B, and C together with the actually photographed images 20c of the medicine bottles containing the medicinal liquids, in order of mixing and preparing processes from left to right.

[0179] The operator mounts the medicine bottles 20 on the medicine bottle mounting portion 14a and the infusion bag 21 on the infusion bag mounting portion 15a according to the instruction on the display 17a.

[0180] At this point, as described above, it is determined whether or not errors occur in the types of the set medicine bottles (medicinal liquids) and the arrangement order of the medicine bottles, according to the changes in weight measured by the medicine bottle weight measurement unit 14. As described above, an image indicating the occurrence of an error may be displayed on the display 17a when errors are recognized through auditing in checking the types of the medicine bottles (medicinal liquids) and so on (an error information producing step). Alternatively, a buzzer sound (warning sound) may be made to alarm the occurrence of an error.

[0181] At this point, as described above, the control unit 18 may count the number of changes in weight measured by the medicine bottle weight measurement unit 14, and based on the counting result, calculate the number of the set medicine bottles 20.

[0182] Further, the control unit 18 recognizes, as the initial weight of the infusion bag 21, the weight measured by the infusion bag weight measurement unit 15 when the infusion bag 21 is placed on the infusion bag mounting portion 15a, and stores the initial weight in the storage unit 19.

[0183] The operator sets all the medicine bottles 20 on the medicine bottle mounting portion 14a, places the infusion bag 21 on the infusion bag mounting portion 15a, and operates the done button 17d on the display 17a (step S14), followed by step S15.

[0184] Incidentally, the control unit 18 automatically recognizes that all the medicine bottles 20 are set on the medicine bottle mounting portion 14a and the infusion bag 21 is placed on the infusion bag mounting portion 15a, and then the process may move to step S15. The completion of setting of the medicine bottles 20 can be determined from, for example, the auditing result of checking the types of the set medicine bottles 20 (the types of the medicinal liquids). Incidentally, for example, the completion of setting of the medicine bottles 20 can be determined according to whether or not the weight measured by the medicine bottle weight measurement unit 14 coincides with data on the total value of the initial weight of all the medicine bottles 20 stored beforehand in the storage unit 19. Such a coincidence means that the measured weight coincides with the data on the total value within the margin of error. In the case where the data on the total value of the initial weight of all the medicine bottles is contained in the information about medicinal liquids, the contained data may be used. Alternatively, the control unit 18 may calculate the total

value of the initial weight of all the medicine bottles by using the data on the initial weight of all the medicine bottles contained in the information about medicinal liquids, and store the calculation result in the storage unit 19.

[0185] Incidentally, the control unit 18, as described above, may audit in counting of the set medicine bottles before moving to step S15. Further, as described above, an image indicating the occurrence of an error may be displayed on the display 17a when errors are recognized through auditing in counting the medicine bottles (medicinal liquids) (the error information producing step). Alternatively, a buzzer sound (warning sound) may be made to alarm the occurrence of an error.

[0186] In step S15, as shown in FIG. 13, an image instructing the operator to remove the syringe driving device 23 from the cradle 16, to fit the syringe 23a to the removed syringe driving device 23, and to attach an injection needle 23b to the syringe 23a fitted to the syringe driving device 23 is displayed on the display 17a of the information presentation unit 17.

[0187] The operator, following the instruction displayed on the display 17a, removes the syringe driving device 23 from the cradle 16, fits the syringe 23a to the removed syringe driving device 23, attaches the injection needle 23b to the syringe 23a fitted to the syringe driving device 23, and then returns the syringe driving device 23 to the cradle 16.

[0188] At this point, the control unit 18 recognizes, as the initial weight of the syringe driving device 23, weight measured by the cradle 16 when the syringe driving device 23 is returned to the cradle 16, and stores the initial weight in the storage unit 19.

[0189] The operator operates the done button 17d on the display 17a after returning the syringe driving device 23 to the cradle 16. By this operation, the process moves to step S16. Incidentally, the control unit 18 automatically recognizes that the syringe driving device 23 is returned to the cradle 16, and then the process may move to step S16. Whether or not the syringe driving device 23 is returned can be determined according to, for example, whether or not the weight measured by the cradle 16 changes from zero.

[0190] In step S16, as shown in FIG. 14, an image indicating the medicine bottle to be suctioned for the operator is displayed on the display 17a of the information presentation unit 17, based on the information about medicinal liquids stored in the storage unit 19. FIG. 14 shows a case where the medicine bottle to be suctioned is the medicine bottle A. In this embodiment, the actually photographed images 20c of the medicine bottles to be suctioned as well as the names and amounts of the medicinal liquids therein are enlarged and shown on the medicinal liquid information display 17f showing the actually photographed images 20c of the medicine bottles. Thus, errors in the selection of the medicine bottles can be prevented since the operator can visually confirm the medicine bottle to be picked up.

[0191] Furthermore, in the case where the information about medicinal liquids includes the information of cautions at the time of withdrawing medicinal liquids, such as a driving speed of the syringe driving device 23, a caution 17g contained in the information about medicinal liquids is displayed on the display 17a in step S16. Safer and more accurate preparation of medicinal liquids can be achieved by indicating such cautions for the operator. FIG. 14 shows, as an example, the caution 17g indicating that the syringe driving device 23 has to be operated at a low speed, since the medicinal liquid A easily bubbles. The operator operates the syringe

driving device 23 according to the caution 17g, so that bubbles can be prevented and the medicinal liquid can be efficiently withdrawn.

[0192] In this embodiment, in step S16, the LED display unit starts emitting light corresponding to the medicine bottle 20 to be suctioned. The instruction display 17c displays an instruction to withdraw the medicinal liquid from the medicine bottle 20 corresponding to the position where the LED display unit emits light (an LED display position). The LED display unit continues emitting light until the picked up medicine bottle 20 is returned onto the medicine bottle mounting portion 14a.

[0193] The operator picks up the medicine bottle 20 according to the instruction displayed on the display 17a. At this point, as described above, the control unit 18 calculates the weight of the picked up medicine bottle 20 based on the changes in weight measured by the medicine bottle weight measurement unit 14. Thus, auditing in checking the types of the picked up medicine bottles 20 (the types of the medicinal liquids) and the pickup order of the medicine bottles 20 is performed (step S16A). At this point, as described above, the control unit 18 may also count the number of changes in weight measured by the medicine bottle weight measurement unit 14, and based on the counting result, calculate the number of times the medicine bottles 20 are picked up from the medicine bottle mounting portion 14a the number of the picked up medicine bottles 20).

[0194] The operator operates the done button 17d on the display 17a after picking up the medicine bottles 20, unless the medicinal liquid preparation assist system 10 issues an error warning. By this operation, the process moves to step S17. Incidentally, the process may automatically move to step S17 when the correct state is recognized from the auditing result in step S16A. Alternatively, the control unit 18 automatically recognizes that the medicine bottles 20 are picked up from the medicine bottle mounting portion 14a, and then, the process may move to step S17. Whether or not the medicine bottles are picked up can be determined according to, for example, whether or not the weight measured by the medicine bottle weight measurement unit 14 decreases.

[0195] When the operator picks up the wrong medicine bottle 20, as described above, an image indicating the occurrence of an error is displayed on the display 17a (the error information producing step). Alternatively, a buzzer sound (warning sound) may be made to alarm the occurrence of an error.

[0196] When the error is fixed, in other words, the medicine bottle erroneously picked up by the operator is returned onto the medicine bottle mounting portion 14a, the process returns to step S16. It is automatically determined whether or not the error is fixed; for example, according to whether or not the weight measured by the medicine bottle weight measurement unit 14 increases.

[0197] In step S17, it is determined whether or not the picked up medicine bottle 20 is a vial container. The determination is made by the control unit 18 based on the information about medicinal liquids stored in the storage unit 19. When the medicine bottle 20 is a vial container, the process moves to step S18. Meanwhile, when the medicine bottle 20 is not a vial container, the process moves to step S19.

[0198] In step S18, an image indicating the amount of air to be withdrawn into the syringe and the instruction to pump suction the medicinal liquid for the operator is displayed on the display 17a of the information presentation unit 17,

according to the information about medicinal liquids stored in the storage unit 19. FIG. 15 illustrates the instruction display 17c which instructs to pump suction the medicinal liquids after withdrawing 10 ml of air into the syringe 23a. The information about the operation order of the syringe driving device 23 is contained in the information about medicinal liquids.

[0199] In the case where the medicine bottle 20 is a vial container, an amount of replacement air corresponding to the amount of the medicinal liquid to be withdrawn has to be withdrawn into the syringe 23a beforehand, in order to keep the internal pressure of the vial container as constant as possible at the time of withdrawing the medicinal liquid. Pumping suctioning has to be performed. Therefore, when the medicine bottle 20 is a vial container, the operation order of the syringe driving device 23 is shown to the operator, so that the operator can operate the syringe driving device 23 in accordance with the instruction displayed on the display 17a and withdraw the medicinal liquid efficiently.

[0200] As described above, the operation order of the syringe driving device 23 is shown to the operator, so that the operator can withdraw the medicinal liquid efficiently. Incidentally, as a matter of course, the information about the operation order of the syringe driving device 23 is not limited to the instruction on the instruction display 17c in FIG. 15.

[0201] The operator operates the done button 17d on the display 17a after withdrawing the medicinal liquids from the picked up medicine bottles 20. By this operation, the process moves to step S19.

[0202] Incidentally, the amount of air to be withdrawn to the syringe is set slightly smaller than the amount of the medicinal liquid. By this setting, the inside of the vial container can be always at a negative pressure while the predetermined amount of the medicinal liquid is withdrawn. Hence, a so-called aerosol phenomenon is prevented in which the residual medicinal liquid comes out of the vial container when the injection needle 23b is removed from the vial container.

[0203] In step S19, as shown in FIG. 16, an image which instructs the operator to return the medicine bottle is displayed on the display 17a of the information presentation unit 17 based on the information about medicinal liquids stored in the storage unit 19. FIG. 16 illustrates that the medicine bottle to be returned is the medicine bottle A. In this embodiment, the actually photographed image 20c and so forth of the medicine bottle to be returned are enlargedly shown. Further in this embodiment, the LED display unit corresponding to the medicine bottle to be returned emits light, and an instruction to return the medicine bottle to the position where the LED unit emits light (the LED display position) is shown on the instruction display 17c. With this configuration, the operator can return the medicine bottle 20 to the original position more reliably.

[0204] The operator returns the medicine bottle 20 according to the instruction on the display 17a after withdrawing the medicinal liquid from the picked up medicine bottle 20. At this point, as described above, the control unit 18 calculates the weight or amount of the withdrawn medicinal liquid based on the changes in weight measured by the medicine bottle weight measurement unit 14. Based on this calculation, auditing in measuring the amounts of withdrawn medicinal liquids, checking the types of withdrawn medicinal liquids, and the mixing and preparing order of medicinal liquids is performed (step S19A).

[0205] At this point, as described above, the control unit 18 may also count the number of changes in weight measured by the medicine bottle weight measurement unit 14, and based on the counting result, calculate the number of times the medicine bottle 20 is returned to the medicine bottle mounting portion 14a (the number of returned medicine bottles 20).

[0206] The operator operates the done button 17d on the display 17a after returning the medicine bottles 20 to the medicine bottle mounting portion 14a, unless the medicinal liquid preparation assist system 10 issues an error warning (step S20). By this operation, the process moves to step S21. Incidentally, the process may automatically move to step S21 when the correct state is recognized from the auditing result in step S19A. Alternatively, the control unit 18 automatically recognizes that the medicine bottle 20 is returned, and then the process may move to step S21. Whether or not the medicine bottle is returned can be determined according to, for example, whether or not the weight measured by the medicine bottle weight measurement unit 14 increases.

[0207] In step S21, whether or not the medicinal liquids have been withdrawn from all the medicine bottles 20 on the medicine bottle mounting portion 14a is determined by comparing the number of the medicine bottles calculated in step S16A or step S19A and the data on the number of the medicine bottles (the predetermined value) stored beforehand in the storage unit 19. When the number of the medicine bottles, from which the medicinal liquids have been withdrawn, coincides with the number of all the medicine bottles 20 on the medicine bottle mounting portion 14a, the process moves to step S22. When the number of the medicine bottles, from which the medicinal liquids have been withdrawn, does not coincide with the number of all the medicine bottles 20 on the medicine bottle mounting portion 14a, the process returns to step S16. The steps S16 to S21 are repeated until the number of the medicine bottles, from which the medicinal liquids have been withdrawn, coincides with the number of all the medicine bottles 20 on the medicine bottle mounting portion 14a.

[0208] When errors such as in the amount of withdrawn medicinal liquids are found by auditing in step S19A, an image which indicates the occurrence of an error is displayed, as described above, on the display 17a (the error information producing step). Alternatively, a buzzer sound (warning sound) may be made to alarm the occurrence of an error. At this point, prescription ID and auditing information indicating errors such as in the amounts of the withdrawn medicinal liquids are retrieved from the storage unit 19 and sent to the medical information database 12 by the control unit 18. The medical information database 12 registers the received auditing information in association with prescription ID. The control unit 18 also displays an image instructing the operator to remove the prescription 25 from the reader 24 on the display 17a.

[0209] Thus, when errors such as in the amount of the withdrawn medicinal liquids are found by auditing in step S19A, the present process of preparing medicinal liquids is stopped. The operator starts preparing medicinal liquids again from the beginning (the start of FIG. 8).

[0210] In step S22, as shown in FIG. 17, an image which instructs the operator to insert the injection needle 23b into the spout plug 21a of the infusion bag 21 and inject the medicinal liquid in the syringe 23a into the infusion bag 21 is displayed on the display 17a of the information presentation

unit 17. Incidentally, FIG. 17 illustrates the infusion bag 21 filled with 500 ml of a normal saline solution beforehand.

[0211] The operator injects the medicinal liquid into the infusion bag 21 according to the instruction on the display 17a. Incidentally, in step S22, the information about the operation and driving speed of the syringe driving device 23 may also be displayed on the display 17a based on the information about medicinal liquids stored in the storage unit 19.

[0212] At this point, as described above, auditing in measuring the amounts of the injected medicinal liquids is performed based on the changes in weight measured by the infusion bag weight measurement unit 15. Further, as described above, an image which indicates the occurrence of an error is displayed on the display 17a when an error occurs in the amounts or weight of the injected medicinal liquids (the error information producing step). Alternatively, a buzzer sound (warning sound) may be made to alarm the occurrence of an error. With this configuration, the operator can confirm that the medicinal liquid remains in the syringe 23a. In such case, the operator injects the medicinal liquid remaining in the syringe 23a into the infusion bag 21. By this auditing, the operator can easily confirm whether or not the medicinal liquid withdrawn into the syringe 23a is completely injected into the infusion bag 21.

[0213] The operator operates the done button 17d on the display 17a after injecting the medicinal liquids into the infusion bag 21. By this operation, the process moves to step S23. Incidentally, the control unit 18 automatically recognizes that the medicinal liquids are injected into the infusion bag 21, and then the process may move to step S23. Whether or not the medicinal liquids are injected into the infusion bag 21 can be determined according to, for example, whether or not weight measured by the infusion bag weight measurement unit 15 increases.

[0214] In step S23, as shown in FIG.18, an image which instructs the operator to remove the injection needle 23b from the syringe 23a fitted to the syringe driving device 23 and return the syringe driving device 23 to the cradle 16 is displayed on the display 17a of the information presentation unit 17.

[0215] The operator returns the syringe driving device 23 to the cradle 16 according to the instruction on the display 17a. At this point, as described above, the cradle 16 measures the weight of the syringe driving device 23 (a syringe driving device weight measuring step), and the control unit 18 determines whether or not the medicinal liquid remains in the syringe 23a based on the weight measured by the cradle 16 and stores the determination result in the storage unit 19 as auditing information (a third auditing information producing step). This auditing is performed since spilling of medicinal liquids at the time of injecting medicinal liquids into the infusion bag 21 cannot be determined only by auditing in measuring the amount of medicinal liquids injected into the infusion bag 21. Whether or not the medicinal liquid remains in the syringe 23a can be reliably determined by auditing of whether or not the medicinal liquid remains in the syringe 23a based on the weight measured by the cradle 16. An image which indicates the occurrence of an error is shown on the display 17a, as described above, when the medicinal liquid is found remaining in the syringe 23a (the error information producing step). Alternatively, a buzzer sound (warning sound) may be made to alarm the occurrence of an error. In this case, the operator injects the remaining medicinal liquid in the syringe 23a into the infusion bag 21.

[0216] The operator operates the done button 17d on the display 17a after returning the syringe driving device 23 to the cradle 16. By this operation, the process moves to step S24. Incidentally, the control unit 18 automatically recognizes that the syringe driving device 23 is returned to the cradle 16, and then the process may move to step S24. Whether or not the syringe driving device 23 is returned to the cradle 16 can be determined according to, for example, whether or not the weight measured by the cradle 16 increases.

[0217] In step S24, information about a patient and auditing information are displayed on the display 17a of the information presentation unit 17, as shown in FIG. 19, based on the information about a patient and auditing information stored in the storage unit 19.

[0218] The operator operates the done button 17d on the display 17a after confirming the information about a patient and auditing information. By this operation of the done button 17d, a geometric pattern having a high contrast ratio, as shown in FIG. 20, appears on the display 17a of the information presentation unit 17. Therefore, the operator can visually and easily confirm extraneous substances contained in the medicinal liquids in the infusion bag 21 and cloudiness of the medicinal liquids in the infusion bag 21 by using the display 17a as the background of the infusion bag 21.

[0219] A nurse or a pharmacist, as an auditor, confirms the auditing information and the information about a patient shown on the display 17a, visually confirms the mixed state of the medicinal liquids in the infusion bag 21, and then operates the done button on the display 17a. By this operation, the process moves to step S25.

[0220] In step S25, an image (not shown) which inquires of the operator about whether or not the auditing result is normal is displayed on the display 17a of the information presentation unit 17. The operator selects whether the auditing result is OK or NG according to the instruction on the display 17a. The operator may achieve this selection, for example, by operating an OK button or an NG button on the display 17a.

[0221] When the auditing result is OK, the process moves to step S26. In step S26, the prescription ID and auditing information stored in the storage unit 19 are sent to the medical information database 12 by the control unit 18. The medical information database 12 registers the received auditing information in association with the prescription ID. In the meantime, as shown in FIG. 21, an image indicating that the auditing information is being registered into the medical information database 12 is displayed on the display 17a of the information presentation unit 17.

[0222] When the transmission of the auditing information to the medical information database 12 is completed, the process moves to step S27. In step S27, as shown in FIG. 22, an image which instructs the operator to stamp the prescription 25 is displayed on the display 17a of the information presentation unit 17.

[0223] The operator removes the prescription 25 from the reader 24 and stamps the removed prescription 25 according to the instruction shown on the display 17a. The operator operates the done button 17d on the display 17a after removing the prescription 25 from the reader 24 (step S28). By this operation, the process moves to step S29. Incidentally, the control unit 18 may be configured to automatically determine whether or not the operator has removed the prescription 25 from the reader 24 including a sensor which produces signals at different levels according to whether or not the prescription 25 is inserted into the reader 24.

[0224] In step S29, an image (not shown) which instructs the operator to dispose of the syringe 23a and the medicine bottles 20 is displayed on the display 17a of the information presentation unit 17. The operator disposes of the used medicine bottles 20 on the medicine bottle mounting portion 14a according to the instruction displayed on the display 17a. The operator also removes the syringe 23a from the syringe driving device 23 held on the cradle 16 and disposes of the syringe.

[0225] The operator operates the done button 17d on the display 17a after disposing of the syringe 23a and the medicine bottles 20 (step S30). By this operation, the process of preparing medicinal liquids ends. Alternatively, the control unit 18 automatically recognizes that all the medicine bottles 20 are picked up from the medicine bottle mounting portion 14a and that the syringe driving device 23 is removed from the cradle 16, and then the process may be completed. Whether or not all the medicine bottles are removed can be determined according to, for example, whether or not the weight measured by the medicine bottle weight measurement unit 14 becomes zero. Whether or not the syringe driving device 23 is picked up from the cradle 16 can be also determined according to, for example, whether or not the weight measured by the cradle 16 becomes zero.

[0226] In contrast, when the auditing result is NG, the process moves to step S31. In step S31, an image (not shown) to input the contents of an error is displayed on the display 17a of the information presentation unit 17.

[0227] The operator inputs the contents of an error according to the instruction displayed on the display 17a. The error information is stored in the storage unit 19 by the control unit 18. The operator operates the done button 17d after inputting the contents of an error (step S32). By this operation, the process moves to step S33.

[0228] In step S33, the prescription ID and the error information stored in the storage unit 19 are sent to the medical information database 12 by the control unit 18. The medical information database 12 records the received error information in association with the prescription ID. In the meantime, an image (not shown) indicating that the error information is being registered into the medical information database 12 is displayed on the display 17a of the information presentation unit 17.

[0229] After the transmission of the error information to the medical information database 12 is completed, the process moves to step S34. In step S34, an image (not shown) which instructs the operator to remove the prescription 25 is displayed on the display 17a of the information presentation unit 17.

[0230] The operator removes the prescription 25 from the reader 24 according to the instruction displayed on the display 17a. The operator operates the done button 17d on the display 17a after removing the prescription 25 from the reader 24 (step S35). By this operation, the process moves to step S29. Incidentally, the control unit 18 may be configured to automatically determine whether or not the operator has removed the prescription 25 from the reader 24 including a sensor which produces signals at different levels according to whether or not the prescription 25 is inserted in the reader 24.

[0231] Thereafter, having passed through the above-described steps S29 and S30, the process of preparing medicinal liquids ends. In the case where the auditing result is NG, the operator starts preparing medicinal liquids again from the beginning (the start of FIG. 8).

[0232] According to the method described above, the auditing processes such as counting of medicine bottles, checking of types of medicine bottles (types of medicinal liquids), the mixing and preparing order of medicinal liquids, measuring of medicinal liquids, and so on can be assisted based on weight measured by the medicine bottle weight measurement unit 14, the infusion bag weight measurement unit 15, and the cradle 16 respectively. Further, by these auditing processes, errors in the setting of medicine bottles, the selection of medicine bottles and the amounts of medicinal liquids at the time of preparing medicinal liquids, and so forth can be prevented. Thus, medicinal liquids can be safely and accurately prepared.

[0233] As described above, auditing in measuring the amount of medicinal liquids withdrawn into the syringe 23a and checking the types of medicinal liquids withdrawn into the syringe 23a may be performed (the third auditing information producing step), through the processes in which the cradle 16 measures the weight of the syringe driving device 23 (the syringe driving device weight measuring step) and the control unit 18 calculates the weight or amounts of withdrawn medicinal liquids based on the weight measured by the cradle 16.

[0234] In FIGS. 8 and 9, all the medicinal liquids to be mixed and prepared are injected into the infusion bag 21 at a time. Even in the case where the medicinal liquids are injected into the infusion bag 21 at multiple times, the method for assisting medicinal liquid preparation can be achieved by the same method as in the specific example of FIGS. 8 and 9. In this case, as described above, the number of times the medicinal liquid is injected may be audited by counting the number of changes in weight measured by the infusion bag weight measurement unit 15. Alternatively, the number of times the medicinal liquid is injected may be audited by counting the number of times weight is measured by the cradle 16.

[0235] Even in the case where the number of types of medicinal liquids to be mixed exceeds the number of medicine bottles can be placed on the medicine bottle mounting portion 14a, a variety of auditing processes can be assisted as in the above-described embodiment, by separating the medicinal liquids to be mixed into a plurality of groups in the mixing and preparing order.

[0236] In the above description, a plurality of types of medicinal liquids are mixed and prepared. However, the medicinal liquid preparation assist system 10 and the method for assisting medicinal liquid preparation according to this embodiment can be applied to a case where a single type of medicinal liquid is injected into the infusion bag.

INDUSTRIAL APPLICABILITY

[0237] According to the medicinal liquid preparation assist system and the method for assisting medicinal liquid preparation of the present invention, the auditing processes such as counting of medicine bottles, checking of types of medicine bottles (types of medicinal liquids), the mixing and preparing order of medicinal liquids, measuring of medicinal liquids, and so on can be assisted. Thus, according to the medicinal liquid preparation assist system and the method for assisting medicinal liquid preparation of the present invention, errors in the setting of medicine bottles, the selection of medicine bottles and the amounts of medicinal liquids at the time of preparing medicinal liquids, and so forth can be prevented, so that medicinal liquids can be safely and accurately prepared. Further, according to the medicinal liquid preparation assist

system and the method for assisting medicinal liquid preparation of the present invention, nurses, pharmacists and so forth can handle medicinal liquid more safely and accurately. Thus, the medicinal liquid preparation assist system and the method for assisting medicinal liquid preparation of the present invention can drastically reduce workloads on nurses, pharmacists and so forth, and are useful for preparing medicinal liquid in the field of medicine and so forth.

1. A medicinal liquid preparation assist system comprising:

- a medicine bottle weight measurement unit having a medicine bottle mounting portion on which medicine bottles are placed, and a first weight measurement portion for measuring total weight of all the medicine bottles placed on the medicine bottle mounting portion;

- an infusion bag weight measurement unit having an infusion bag mounting portion on which an infusion bag is placed; and a second weight measurement portion for measuring weight of the infusion bag placed on the infusion bag mounting portion;

- a storage unit;

- a control unit for comparing changes in weight measured by the medicine bottle weight measurement unit with changes in weight measured by the infusion bag weight measurement unit, producing auditing information based on a result of the comparison, and storing the produced auditing information in the storage unit; and
- an information presentation unit for displaying at least one of information about medicinal liquids to be injected to the infusion bag, the information being stored beforehand in the storage unit, and the auditing information stored in the storage unit by the control unit.

2. The medicinal liquid preparation assist system according to claim 1, wherein the control unit counts a number of the changes in weight measured by the medicine bottle weight measurement unit or a number of the changes in weight measured by the infusion bag weight measurement unit.

3. The medicinal liquid preparation assist system according to claim 2, wherein the control unit calculates a number of the medicine bottles on the medicine bottle mounting portion or a number of the medicinal liquids injected to the infusion bag on the infusion bag mounting portion based on the counted numbers of the changes in weight, produces auditing information by comparing the calculated number of the medicine bottles or of the injected medicinal liquids with a predetermined value, and stores the produced auditing information in the storage unit.

4. The medicinal liquid preparation assist system according to claim 1, further comprising:

- a reader for reading prescription identification data or an input unit through which the prescription identification data is inputted; and

- a medical information database for storing the information about the medicinal liquids, wherein the control unit sends the prescription identification data to the medical information database,

- the medical information database sends the information about the medicinal liquids in accordance with the received prescription identification data, and

- the control unit stores the information about the medicinal liquids from the medical information database in the storage unit.

5. The medicinal liquid preparation assist system according to claim 1, further comprising a syringe weight measurement

portion having a holder for holding a syringe driving device with a syringe attached thereto, and a third weight measurement portion for measuring weight of the syringe driving device held by the holder, wherein

- the control unit compares the changes in weight measured by the medicine bottle weight measurement unit, the changes in weight measured by the infusion bag weight measurement unit, and changes in weight measured by the syringe weight measurement portion, produces auditing information based on a result of the comparison, and stores the produced auditing information in the storage unit.

6. The medicinal liquid preparation assist system according to claim 1, further comprising a camera, wherein

- the control unit displays, on the information presentation unit, actually photographed images of the medicine bottles containing the medicinal liquids to be injected into the infusion bag on the infusion bag mounting portion arranged in mixing and preparing order, and compares the actually photographed images and images of the medicine bottles on the medicine bottle mounting portion photographed by the camera.

7. The medicinal liquid preparation assist system according to claim 1, wherein the control unit calculates weight or amounts of the withdrawn medicinal liquids based on the changes in weight measured by the medicine bottle weight measurement unit when the medicinal liquids are withdrawn from the medicine bottles on the medicine bottle mounting portion, compares the calculated weight or amounts of the medicinal liquids with a predetermined value, and produces withdrawal error information indicating at least one of errors in the amounts of the withdrawn medicinal liquids, errors in types of the withdrawn medicinal liquids, and spilling of the medicinal liquids when the calculated weight or amounts of the medicinal liquids do not coincide with the predetermined value.

8. A method for assisting medicinal liquid preparation, the method comprising:

- a medicine bottle weight measuring step of measuring total weight of medicine bottles placed on a medicine bottle mounting portion;

- an infusion bag weight measuring step of measuring weight of an infusion bag placed on an infusion bag mounting portion; and

- an auditing information producing step of comparing changes in weight measured by the medicine bottle weight measuring step and changes in weight measured by the infusion bag weight measuring step, producing auditing information based on a result of the comparison, and storing the produced auditing information in a storage unit.

9. The method for assisting medicinal liquid preparation according to claim 8, further comprising a number counting step of counting a number of the changes in weight measured by the medicine bottle weight measuring step or a number of the changes in weight measured by the infusion bag weight measuring step.

10. The method for assisting medicinal liquid preparation according to claim 9, further comprising the step of calculating a number of the medicine bottles on the medicine bottle mounting portion or a number of the medicinal liquids injected into the infusion bag on the infusion bag mounting portion based on the number counted by the number counting step, producing auditing information by comparing the cal-

culated number of the medicine bottles or the calculated number of the injected medicinal liquids with a predetermined value, and storing the produced auditing information in the storage unit.

11. The method for assisting medicinal liquid preparation according to claim **8**, further comprising a syringe weight measuring step of measuring weight of a syringe driving device with a syringe attached thereto, wherein

in the auditing information producing step, the changes in weight measured by the medicine bottle weight measuring step, the changes in weight measured by the infusion bag weight measuring step, and changes in weight measured by the syringe weight measuring step are compared, auditing information is produced based on a result of the comparison, and the produced auditing information is stored in the storage unit.

12. The method for assisting medicinal liquid preparation according to claim **8**, further comprising the steps of:

reading prescription identification data;

sending the read prescription identification data to a medical information database; and

receiving, from the medical information database, information about medicinal liquids in accordance with the prescription identification data, and storing the received information about the medicinal liquids in the storage unit.

13. The method for assisting medicinal liquid preparation according to claim **8**, further comprising the steps of:

displaying actually photographed images of medicine bottles containing medicinal liquids to be injected into the infusion bag on the infusion bag mounting portion arranged in mixing and preparing order; and

comparing the actually photographed images with photographed images of the medicine bottles on the medicine bottle mounting portion.

14. The method for assisting medicinal liquid preparation according to claim **8**, further comprising the step of displaying information about an operation or a driving speed of a syringe driving device, based on information about medicinal liquids to be injected into the infusion bag stored in the storage unit, before the medicinal liquids are withdrawn into a syringe.

15. A method for assisting medicinal liquid preparation comprising:

a display step of displaying information about medicinal liquids to be injected into an infusion bag, the information being stored in a storage unit;

a medicine bottle weight measuring step of measuring total weight of medicine bottles placed on a medicine bottle mounting portion;

an infusion bag weight measuring step of measuring weight of the infusion bag placed on an infusion bag mounting portion;

a number counting step of counting a number of changes in weight measured by the medicine bottle weight measuring step or a number of changes in weight measured by the infusion bag weight measuring step; and

the step of calculating a number of the medicine bottles on the medicine bottle mounting portion or a number of the medicinal liquids injected into the infusion bag on the infusion bag mounting portion based on the number

counted by the number counting step, producing auditing information by comparing the calculated number of the medicine bottles or the calculated number of the injected medicinal liquids with a predetermined value, and storing the produced auditing information in the storage unit.

16. The method for assisting medicinal liquid preparation according to claim **8**, further comprising the steps of:

calculating weight or amounts of withdrawn medicinal liquids based on the changes in weight measured by the medicine bottle weight measuring step, and comparing the calculated weight or amounts of the withdrawn medicinal liquids with a predetermined value; and

producing withdrawal error information indicating at least one of errors in the amounts of the withdrawn medicinal liquids, errors in types of the withdrawn medicinal liquids, and spilling of the medicinal liquids when it is recognized that the calculated weight or amounts of the withdrawn medicinal liquids do not coincide with the predetermined value.

17. The method for assisting medicinal liquid preparation according to claim **8**, further comprising the steps of:

calculating changes in weight or amount of medicinal liquids injected into the infusion bag based on the weight measured by the infusion bag weight measuring step, and comparing the calculated changes in weight or amount of the medicinal liquids with a predetermined value; and

producing injection error information indicating at least one of errors in the amounts of the injected medicinal liquids, errors in types of the injected medicinal liquids, remaining of the medicinal liquids in a syringe, and spilling of the medicinal liquids, when it is recognized that the calculated changes in weight or amount of the injected medicinal liquids do not coincide with the predetermined value.

18. The method for assisting medicinal liquid preparation according to claim **11**, further comprising the steps of:

determining whether or not a medicinal liquid withdrawn into the syringe is all injected into the infusion bag based on the weight measured by the syringe weight measuring step; and

producing residual error information when it is recognized that the medicinal liquid remains in the syringe.

19. The method for assisting medicinal liquid preparation according to claim **11**, further comprising the steps of:

calculating weight or an amount of a medicinal liquid withdrawn into the syringe based on the weight measured by the syringe weight measuring step, and comparing the calculated weight or amount of the withdrawn medicinal liquid with a predetermined value; and

producing withdrawal error information indicating at least one of errors in the amounts of the withdrawn medicinal liquids, errors in types of the withdrawn medicinal liquids, and spilling of the medicinal liquids, when it is recognized that the calculated weight or amount of the withdrawn medicinal liquid does not coincide with the predetermined value.

20. (canceled)

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