# DESCRIPTION

## TITLE OF INVENTION

## MEDICAL PUMP HOUSING RACK AND CONTROL METHOD THEREOF

## TECHNICAL FIELD

[0001] The present invention relates to a medical pump housing rack which houses a plurality of arranged medical pumps and a control method therefor.

## BACKGROUND ART

[0002] In medical settings such as a hospital, as a pump for administering a drug into the body of a patient, there is used an infusion pump which injects a drug in an infusion bag into the body through an infusion tube at a controlled infusion speed, a syringe pump which injects a drug in a syringe into the body at a controlled infusion speed, or the like.

[0003] In general, such an infusion pump and a syringe pump (these pumps will be collectively termed medical pumps in this specification) are used to infuse one type of drug. For this reason, in order to simultaneously administer a plurality of types of drugs into a patient in an operating room, intensive care unit, or the like, it is necessary to use a plurality of medical pumps corresponding to the types of drugs.

[0004] In addition, an infusion bag or syringe is charged with only a predetermined amount of drug in advance. To administer a large amount of the same type

of drug into a patient, it is necessary to prepare a plurality of medical pumps corresponding to the amount to be administered in advance and sequentially operate them (note that a method of continuously administering the same type of drug by sequentially operating a plurality of medical pumps in this manner is called the "W method").

[0005] As described above, in many medical fields, a plurality of medical pumps are used for one patient. In such a case, juxtaposing medical pumps on a desk or placing them on a floor will interfere with operation by a doctor or the like. In addition, moving these pumps will increase the operation load. The common practice is therefore to use a medical pump housing rack which houses arranged medical pumps (see, for example, PTL1).

CITATION LIST

PATENT LITERATURE

[0006]

PTL1: Japanese Patent Laid-Open No. 11-347118

## SUMMARY OF INVENTION

### TECHNICAL PROBLEM

[0007] If, however, a plurality of medical pumps are arranged and housed in a medical pump housing rack, there is a risk of operating a medical pump different from a medical pump to be operated. When operating a

plurality of medical pumps in cooperation with each other by the W method described above, the setting operation, the operation instruction operation, and the like become more complicated than those in a general infusing operation. This tends to cause operation errors.

[0008] When performing infusion by the W method, it is important for each of the medical pumps to be operated in cooperation with each other to monitor not only an operation error on itself by the user but also the operation states of other medical pumps to be operated in cooperation. This is because it is necessary to cancel the cooperation or stop operation depending on the operation states of other medical pumps.

[0009] For the above reason, when performing infusion by the W method using a plurality of medical pumps housed in a medical pump housing rack, the medical pump housing rack is preferably configured to prevent the user from making operation errors by monitoring each medical pump.

[0010] The present invention has been made in consideration of the above problem, and has as its object to provide a medical pump housing rack which monitors a plurality of medical pumps which perform infusion by the W method and reduces operation errors on the medical pumps by the user.

SOLUTION TO PROBLEM

[0011] In order to achieve the above object, a medical pump housing rack according to the present invention includes the following arrangement. That is,

a medical pump housing rack which houses a plurality of arranged medical pumps and is communicatively connected to the housed medical pumps is characterized by comprising:

cooperation permission/inhibition determination means for determining whether two predetermined medical pumps of the plurality of housed medical pumps are configured to operate in cooperation with each other, based on information indicating housing positions at which the two medical pumps are respectively housed and drug information set in each of the two medical pumps; and

cooperation permission notification transmission means for, if the cooperation permission/inhibition determination means determines that the two medical pumps are configured to operate in cooperation with each other, transmitting, to the two medical pumps, cooperation permission notifications for validating operation of issuing infusion start instructions for a drug to the two medical pumps.

ADVANTAGEOUS EFFECTS OF INVENTION

[0012] According to the present invention, it is possible to provide a medical pump housing rack which

monitors a plurality of medical pumps which perform infusion by the W method and reduces operation errors on the medical pumps by the user.

[0013] Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings. Note that the same reference numerals denote the same or like components throughout the accompanying drawings.

## BRIEF DESCRIPTION OF DRAWINGS

[0014] The accompanying drawings are included in the specification, constitute a part of the specification, illustrate the embodiments of the present invention, and are used to explain the principle of the present invention together with the description.

Fig. 1 is a chart for explaining infusion by the W method;

Fig. 2A is a perspective view showing the outer arrangement of a medical pump housing rack;

Fig. 2B is a perspective view showing the outer arrangement of the medical pump housing rack;

Fig. 3 is a block diagram showing a control arrangement in a medical pump housing rack housing a plurality of medical pumps;

Fig. 4 is a view for explaining the operations of a starting pump and subsequent pump when performing

infusion by the W method and various types of processes in the W method monitoring function of a medical pump housing rack 200 in this case;

Fig. 5 is a flowchart showing a detailed procedure for cooperation permission/inhibition determination processing in the medical pump housing rack;

Fig. 6 is a flowchart showing a detailed procedure for cooperation establishment determination processing in the medical pump housing rack; and

Fig. 7 is a flowchart showing a procedure for infusion start processing in a medical pump.

## DESCRIPTION OF EMBODIMENTS

[0015] Each embodiment of the present invention will be described in detail below with reference to the accompanying drawings, as needed. Note that the present invention is not limited to the following embodiments and can be modified, as needed.

[0016] <1. Explanation about Infusion by W Method>

Infusion by the W method will be described first. The W method is an administration method of continuously infusing the same drug to a patient without changing the flow rate by sequentially operating two medical pumps.

[0017] In general, in the operation of two medical pumps, if the flow rate of infusion by each medical

pump is low, the startup of the second medical pump (subsequent pump) for infusion slows down. The W method is designed to avoid variations in flow rate accompanying such an infusion startup delay by starting infusion by the second pump (subsequent pump) a little before the end of infusion by the first pump (starting pump) instead of after the end of infusion by the first pump.

[0018] The W method controls infusion so as to keep the combined flow rate of the two medical pumps almost constant and set the flow rate of the subsequent pump to the flow rate at the cooperation start time when infusion by the starting pump is finally complete. Note that the manner of controlling the combined flow rate is not limited to this. For example, in order to avoid flow rate variations accompanying startup delays in infusion by the subsequent pump, the combined flow rate of the two medical pumps in cooperation may be controlled based on a reference flow rate which is set in advance such that the combined flow rate exceeds it (note that the "reference flow rate" is the flow rate of the starting pump immediately before cooperation start (the flow rate to be inherited by the subsequent pump)).

[0019] Fig. 1 is a chart showing temporal changes in the flow rate of each of two predetermined medical pumps (pumps A and B) and temporal changes in the

combined flow rate of the two pumps when infusion is performed by the W method using the two pumps.

[0020] In this chart, a graph 100 represents temporal changes in the flow rate of the pump A (starting pump) which performs infusion first, and a graph 110 represents temporal changes in the flow rate of the pump B (subsequent pump) which performs infusion after the pump A.

[0021] Note that in the graphs 100 and 110, the operation of changing the flow rate stepwise will be referred to as a "step", and the number of times of changing the flow rate will be referred to as a "step count". In the case of the graphs 100 and 110, the step count is "4".

[0022] Assume that the step count, the time interval between the respective steps, and the flow rate in each step (step flow rate) are stored in advance in the form of a W method table in each medical pump in correspondence with drug information. When the user selects a drug for each medical pump and reads out a corresponding W method table, each medical pump sets a step count, the time interval between the respective steps, and a step flow rate in accordance with the read W method table.

[0023] In addition, setting a step count, the time interval between the respective steps, and a step flow rate will determine a change start timing (cooperation

start timing) in changing the flow rate stepwise and a timing at which the flow rate becomes 0 (cooperation end timing). Assume that in this embodiment, the above step flow rate is set as a ratio when the flow rate of the pump A (starting pump) at the cooperation start timing is 100%.

[0024] Performing infusion by the W method will control the pumps A and B in accordance with the temporal changes indicated by the graphs 100 and 110. This keeps the combined flow rate of the pumps A and B almost constant and makes the flow rate of the pump B equal to the flow rate of pump A at the cooperation start timing when infusion by the pump A ends (at the cooperation end timing) (see a graph 120). Note that if, for example, the remaining amount of the pump A becomes 0 (or a remaining amount warning is issued to notify that the remaining amount of the pump A has become small) before transition to the last step in the W method table, control is performed to change the flow rate of pump B to the flow rate in the last step (the flow rate of the pump A at the cooperation start time) regardless of the W method table, thereby keeping the flow rate of the pump B equal to that of the pump A.

[0025] <2. Outer Arrangement of Medical Pump Housing Rack>

The outer arrangement of the medical pump housing rack housing medical pumps which perform infusion by

the W method will be described next.

[0026] Fig. 2A is a perspective view showing the outer arrangement of a medical pump housing rack 200 housing a plurality of medical pumps. As shown in Fig. 2A, the medical pump housing rack 200 is provided with housing portions 201 to 203, each for housing one medical pump, in the vertical direction to vertically dispose a plurality of medical pumps (three medical pumps in this case).

[0027] The housing portions 201 to 203 open at the front to allow medical pumps to be inserted from the front surface side. The back surface sides of the housing portions 201 to 203 are provided with ports 211 to 213 (Fig. 2A shows only the port 211) in correspondence with the housing positions of medical pumps. Each of the ports 211 to 213 is formed from a connector which can be connected to a medical pump. The respective medical pumps are communicatively connected to the medical pump housing rack 200 via the ports 211 to 213. Assume that the ports 211 to 213 are respectively assigned with identification numbers #1, #2, and #3, beginning at the top, in the order of the housing positions of the pumps which are vertically disposed.

[0028] Fig. 2B is a perspective view showing the outer arrangement of the medical pump housing rack 200 housing a plurality of medical pumps.

[0029] Referring to Fig. 2B, medical pumps (infusion pumps) 221 to 223 infuse drugs in infusion bags (not shown) connected to tubes 231 to 233 on the right side on the drawing surface into a patient (not shown) connected to tubes 241 to 243 on the left side on the drawing surface.

[0030] The front surface sides of the medical pumps 221 to 223 are provided with operation buttons for inputting various kinds of settings and various kinds of operation instructions and display units which display infusion states and the like in the medical pumps 221 to 223. The user administers drugs into a patient by operating the respective operation buttons while watching the information displayed on the display units.

[0031] Note that according to the above description, the medical pump housing rack 200 houses three medical pumps. However, the present invention is not limited to this. The above description has exemplified the infusion pumps as the medical pumps to be housed in the medical pump housing rack 200. However, the present invention is not limited to this, and other medical pumps such as syringe pumps may be housed.

[0032] <3. Control Arrangement in Medical Pump System>

Fig. 3 is a block diagram showing an example of a control arrangement for the medical pump housing rack 200 and the medical pumps 221 to 223 according to this

embodiment. The three ports 211 to 213 of the medical pump housing rack 200 are connected to a communication module 302. Upon receiving a signal (data) from one of the medical pumps 221 to 223 via a corresponding one of the ports 211 to 213, the communication module 302 notifies a control unit 301 of the received data and the received port number (one of the port numbers #1 to #3).

[0033] Upon receiving a pair of a port number and data (a command or the like) from the control unit 301, the communication module 302 outputs the data received from the control unit 301 to one of the ports 211 to 213 which corresponds to the port number. This allows the control unit 301 of the medical pump housing rack 200 to separately communicate with the plurality of housed medical pumps 221 to 223. Note that the control unit 301 is a computer including a CPU, ROM, and RAM (none of which are shown), and executes various types of processing programs concerning a W method monitoring function including processing (cooperation permission/inhibition determination processing and cooperation establishment determination processing) shown in the flowcharts of Figs. 5 and 6.

[0034] A display unit 311 of the medical pump 221 includes, for example, a liquid crystal panel, and performs various types of display operations under the control of a pump control unit 312. An operation unit

313 includes operation buttons for inputting various settings and various operation instructions.

[0035] A connector 316 is connected to the port 211 and implements electrical connection (communication) between the medical pump 221 and the medical pump housing rack 200. Assume that the connector 316 is connected to the port 211 via a cable. Alternatively, the connector 316 may be directly connected to the port 211 (for example, the connector 316 may be connected to the port 211 when the medical pump 221 is housed in the medical pump housing rack 200).

[0036] The pump control unit 312 controls an infusion mechanism 314 to control infusion. If the medical pump 221 is an infusion pump, the infusion mechanism 314 includes, for example, a plurality of fingers, which sequentially press an infusion tube to send out a drug into the tube. If the medical pump 221 is a syringe pump, the infusion mechanism 314 is attached with a syringe whose plunger is to be pressed.

[0037] The signal (data) input by the operation unit 313 is transmitted to the medical pump housing rack 200 via the pump control unit 312 and a communication module 315, and is used for various types of processes concerning the above W method monitoring function. The signal (data) transmitted by the medical pump housing rack 200 is received via the communication module 315, and is used by the pump control unit 312 for processing

for infusion by the W method.

[0038] Described below is the W method monitoring function of the medical pump housing rack 200 in a case in which infusion by the W method is performed by using the medical pump 221 as the starting pump and the medical pump 222 as the subsequent pump in the control arrangement described above. Note that in the following description, the starting pump and the subsequent pump will be referred to as the "pump A" and the "pump B", respectively.

[0039] <4. Operation at Time of Infusion by W Method>

Fig. 4 is a chart for explaining the operations of the pump A (starting pump) and pump B (subsequent pump) in infusion by the W method and various types of processes by the W method monitoring function of the medical pump housing rack 200 in this case.

[0040] A method of deciding a starting pump and a subsequent pump will be described first. Assume that the medical pump housing rack 200 has received W method cooperation reservation notifications (W method available drug selection notifications) from the two medical pumps. In this case, if one medical pump has already performed infusion, the medical pump housing rack 200 recognizes the pump as the starting pump (pump A), and notifies the other medical pump that it is the subsequent pump (pump B). If the two medical pumps have not performed infusion, the medical pump housing

rack 200 recognizes, as the starting pump, a pump from which an infusion start notification is received first after the establishment of cooperation reservation, and notifies the other medical pump that it is the subsequent pump. If the two medical pumps have already performed infusion, the medical pump housing rack 200 notifies the two pumps that cooperation is not established.

[0041] After the pumps A and B are decided, the pump A accepts the selection of a drug to be administered in step S401.

[0042] In step S402, the pump A reads out a W method table stored in correspondence with the drug accepted in step S401, and sets a step count, the time interval between the respective steps, and a step flow rate. In addition, the pump A decides and sets a cooperation start timing and a cooperation end timing based on the flow rate set by the user (that is, sets various types of parameters necessary for the execution of infusion by the W method).

[0043] In step S403, the pump A accepts an instruction to cooperate with the other medical pump (the pump B in this case) to implement infusion by the W method.

[0044] Note that information concerning the drug selected in step S401 and a cooperation instruction accepted in step S403 are transmitted to the medical

pump housing rack 200.

[0045] Likewise, the pump B accepts the selection of a drug to be administered in step S411.

[0046] In addition, in step S412, the pump B reads out a W method table stored in correspondence with the drug accepted in step S411, and sets a step count, the time interval between the respective steps, and a step flow rate. In addition, the pump B decides and sets a cooperation start timing and a cooperation end timing based on the flow rate set by the user (that is, sets various types of parameters necessary for the execution of infusion by the W method).

[0047] Note that information concerning the drug selected in step S411 and a cooperation instruction accepted in step S413 are transmitted to the medical pump housing rack 200.

[0048] The medical pump housing rack 200 determines in step S421, based on the information transmitted in steps S401 and S403 and steps S411 and S413, whether the pumps A and B can cooperate with each other.

[0049] If an instruction to make the pumps A and B cooperate with each other is selected in this manner, the medical pump housing rack 200 determines, based on the information transmitted from the pumps A and B, whether the pumps A and B can cooperate with each other. With this arrangement, even if the user has erroneously set a medical pump, which should not cooperate, as a

cooperation target, the user is notified of the operation error (that is, it is possible to reduce operation errors by the user in various types of operations for infusion by the W method). Cooperation permission/inhibition determination processing will be described in detail later.

[0050] Upon determining, as a result of cooperation permission/inhibition determination processing in step S421, that the pumps can cooperate with each other, the medical pump housing rack 200 notifies the pumps A and B of the corresponding information (cooperation permission notification).

[0051] If the cooperation permission/inhibition determination processing result notified in step S421 indicates that the pumps can cooperate with each other, the pump A accepts the input of an infusion start instruction by the user (operation of issuing an infusion start instruction by the user becomes valid) in step S404.

[0052] Upon accepting the input of the instruction, the pump A notifies the medical pump housing rack 200 of the start of infusion, while starting infusion in step S405.

[0053] In step S422, upon receiving a notification indicating the start of infusion by the pump A from the pump A, the medical pump housing rack 200 notifies the pump B of the corresponding information.

[0054] Upon receiving the notification, the pump B validates the operation of issuing an infusion start instruction by the user. Subsequently, the pump B can accept an infusion start instruction until the cooperation start timing is reached.

[0055] In step S414, upon accepting the infusion start instruction input by the user, the pump B notifies the medical pump housing rack 200 of the corresponding information.

[0056] This makes the medical pump housing rack 200 recognize the completion of infusion preparation for the pump B in step S422.

[0057] The pump B as well as the pump A is configured to make the user input an infusion start instruction in consideration of the securement of safety for a patient. Assume that accepting an infusion start instruction from the pump A will make the pumps A and B automatically start infusion. With this arrangement, after an infusion start instruction for the pump A is input, the pump B starts infusion without making the user monitor the state of the pump B.

[0058] With the above arrangement, the medical pump housing rack 200 according to this embodiment can avoid such a situation.

[0059] In step S422, upon recognizing that infusion preparation for the pump B is complete, the medical pump housing rack 200 stands by until the cooperation

start timing.

[0060] In this case, the cooperation start timing in this embodiment is one of the following timings:

[0061] · the timing at which the pump A completes infusion of a scheduled amount;

· the timing (T1 < T2) at which a calculated remaining time (T1) until a drug runs out at the current flow rate of the pump A becomes less than a preset time (T2); and

· the timing (T1 < T3) at which the calculated remaining time (T1) by which a drug runs out at the current flow rate of the pump A becomes less than a calculated arrival time (T3) at which the flow rate of the pump B arrives at a stable flow rate.

Note that if an instruction to change a flow rate setting for the pump A is input to change the flow rate setting during infusion by the pump A while the medical pump housing rack 200 stands by until the cooperation start timing, the pump A transmits the corresponding notification to the medical pump housing rack 200 (step S406). In this case, the medical pump housing rack 200 transmits the flow rate setting change notification received from the pump A to the pump B. Note however that the medical pump housing rack 200 may be configured to notify the pump B of a flow rate setting change notification every time it is issued. Alternatively, the medical pump housing rack 200 may be

configured to notify the pump B of this information upon including it in a flow rate notification issued at the cooperation start timing.

[0062] When the cooperation start timing is reached and the pump A transmits a cooperation start instruction in step S407, the medical pump housing rack 200 recognizes, from the cooperation start instruction transmitted from the pump A, that cooperation has been established between the pumps A and B, and notifies the pumps A and B of the corresponding information (cooperation establishment notification) in step S422. These processes (cooperation establishment determination processing) in step S422 will be described in detail later.

[0063] In step S415, upon receiving a flow rate setting change notification from the medical pump housing rack 200, the pump B sets a step flow rate based on the flow rate setting after the change. In addition, upon receiving the notification indicating that cooperation has been established from the medical pump housing rack 200, the pump B starts infusion. Note that, as described above, the medical pump housing rack 200 may be configured to notify the pump B of a flow rate setting change every time the flow rate changes or to notify the pump B of a flow rate setting change upon including it in a flow rate notification issued at the cooperation start timing. If the medical

pump housing rack 200 notifies the pump B of a flow rate setting change upon including it in a flow rate notification issued at the cooperation start timing, the pump B sets a step flow rate upon receiving the flow rate notification, and starts infusion. Note that these processes (infusion start processing) in the pump B will be described in detail later.

[0064] In this manner, the medical pump housing rack 200 is configured to determine that cooperation has been established between the pump A and the pump B and monitor the infusion states of the pumps A and B afterward. This makes it possible to avoid a situation in which the pump B automatically starts infusion in spite of the fact that infusion by the W method should not be maintained because some trouble has occurred in the pump B.

[0065] In addition, the arrangement of notifying the pump B via the medical pump housing rack 200 of the flow rate setting in the pump A in the process of infusion, which has been changed before the cooperation start timing, can reflect, in the pump B, the change in flow rate setting made by the user in the pump A.

[0066] <5. Details of Operation at Time of Infusion by W Method>

The following is a detailed description about the cooperation permission/inhibition determination processing and cooperation establishment determination

processing performed by the W method monitoring function of the medical pump housing rack 200 and infusion start processing by the pump B in operation at time of infusion by the W method.

[0067] (1) Details of Cooperation Permission/Inhibition Determination Processing (Step S421)

A detailed procedure for cooperation permission/inhibition determination processing (step S421) by the medical pump housing rack 200 will be described first.

[0068] Fig. 5 is a flowchart showing a detailed procedure for cooperation permission/inhibition determination processing by the medical pump housing rack. Upon receiving cooperation instructions from the pumps A and B, the medical pump housing rack starts the cooperation permission/inhibition determination processing shown in Fig. 5.

[0069] In step S501, the medical pump housing rack identifies the housing positions of the pumps A and B which have transmitted the cooperation instructions. Note that the medical pump housing rack identifies the housing positions of the pumps A and B based on the port numbers corresponding to the reception of the cooperation instructions from the respective pumps.

[0070] In step S502, the medical pump housing rack determines, based on the housing positions identified

in step S501, whether the pumps A and B which have transmitted the cooperation instructions are adjacent to each other. More specifically, if the respective port numbers are serial numbers, the medical pump housing rack determines that the pumps are adjacent to each other, and the process advances to step S503. If the respective port numbers are not serial numbers, the medical pump housing rack determines that the pumps are not adjacent to each other, and the process advances to step S506.

[0071] In step S506, the medical pump housing rack notifies the pumps A and B which have transmitted the cooperation instructions of inhibition of cooperation. As described above, a cooperation permission/inhibition condition is limited to that the housing positions of the pumps A and B should be adjacent to each other. This is because making medical pumps, of the plurality of medical pumps housed in the medical pump housing rack 200, which are located at distant positions cooperate with each other may cause the user to make an operation error.

[0072] In step S503, the medical pump housing rack identifies the drugs selected in the pumps A and B which have transmitted the cooperation instructions. In step S504, the medical pump housing rack determines whether the drugs respectively identified in step S503 match.

[0073] If the medical pump housing rack determines in step S504 that the drugs do not match, the user may have selected a wrong drug on the pump A or B or may have erroneously operated a medical pump different from the medical pump to cooperate to input a cooperation instruction. In either case, the medical pump housing rack determines that the user has made an operator error, and notifies the pumps A and B which have transmitted the cooperation instructions of inhibition of cooperation.

[0074] If the medical pump housing rack determines in step S504 that the drugs match, the process advances to step S505 to notify the pumps A and B which have transmitted the cooperation instructions of permission of cooperation (cooperation permission notification).

[0075] As described above, the medical pump housing rack 200 according to this embodiment is configured to determine permission/inhibition of cooperation when the user inputs cooperation instructions on the pumps A and B and to issue a notification immediately upon determining inhibition of cooperation. This makes it possible to reduce operation errors made by the user.

[0076] The pump A which has received the notification of permission of cooperation from the medical pump housing rack 200 can accept an infusion start instruction. This allows the user to start infusion by the pump A.

[0077] (2) Details of Cooperation Establishment Determination Processing (Step S422)

A procedure for cooperation establishment determination processing by the medical pump housing rack 200 will be described next. Fig. 6 is a flowchart showing a detailed procedure for cooperation establishment determination processing by the medical pump housing rack. Upon receiving, from the pump A, a notification indicating that an infusion start instruction has been input, the medical pump housing rack starts the cooperation establishment determination processing shown in Fig. 6.

[0078] In step S601, the medical pump housing rack determines whether it has received a notification indicating that the pump B has input an infusion start instruction. If the medical pump housing rack determines in step S601 that it has received the notification, the process advances to step S602.

[0079] If the medical pump housing rack determines in step S601 that it has not received the notification, the process advances to step S606 to determine whether the cooperation start timing is reached (whether it has received a cooperation start instruction from the pump A). If the medical pump housing rack determines that the cooperation start timing is not reached, the process advances to step S602.

[0080] In step S602, the medical pump housing rack

determines whether the user has changed the flow rate setting of the pump A during infusion. If the medical pump housing rack determines in step S602 that the user has changed the flow rate setting of the pump A during infusion, the process advances to step S603 to notify the pump B of the changed flow rate setting. The process then advances to step S604. Note that the pump B changes the step flow rate or the like based on the notification of the changed flow rate setting. However, the present invention is not limited to this. For example, although the changed flow rate setting is notified to the medical pump housing rack 200, the process may advance to step S604 without executing the processing in step S603. In this case, in step S605, the medical pump housing rack notifies the changed flow rate setting.

[0081] If the medical pump housing rack determines step S602 that the user has not changed the flow rate setting of the pump A during infusion, the process directly advances to step S604.

[0082] In step S604, the medical pump housing rack determines whether the cooperation start timing is reached (whether it has received a cooperation start instruction from the pump A). If the medical pump housing rack determines in step S604 that the cooperation start timing is not reached, the process returns to step S601. If the medical pump housing rack

has not received a notification indicating that the pump B has input an infusion start instruction, the medical pump housing rack waits for an infusion start instruction from the pump B. If the medical pump housing rack has already received a notification indicating that the pump B has input an infusion start instruction, the medical pump housing rack stands by until the cooperation start timing is reached. If, however, the user has changed the flow rate setting of the pump A during infusion, the medical pump housing rack notifies the pump B of the change every time it occurs. However, the present invention is not limited to this. For example, every time the flow rate of the pump A is changed, the pump A notifies the medical pump housing rack 200 of the flow rate change. However, at this point of time, no information may be notified to the pump B, and the final flow rate of the pump A may be notified to the pump B.

[0083] If the medical pump housing rack determines in step S604 that the cooperation start timing is reached, the process advances to step S605 to notify the pumps A and B of the establishment of cooperation (cooperation establishment notification). This causes the pump B to start infusion.

[0084] If the medical pump housing rack determines in step S606 that the cooperation start timing is reached before receiving a notification indicating that a

transmission start instruction has been input from the pump B, the process advances to step S607. In step S607, the medical pump housing rack notifies the pump B of a warning instruction. Upon being notified of the warning instruction, the pump B outputs a warning.

[0085] In step S608, the medical pump housing rack determines whether the user has stopped the pump B from outputting a warning. If the medical pump housing rack determines in step S608 that the user has stopped the pump B from outputting a warning, the process advances to step S605 to notify the pumps A and B of the establishment of cooperation (cooperation establishment notification).

[0086] Although not clearly shown in Fig. 6, if the pump A is removed from the medical pump housing rack 200 or infusion stops due to an abnormality before the cooperation start timing is reached, the medical pump housing rack notifies the pump B of the failure to establish cooperation with the pump B. In this case, the pump B does not automatically start infusion by the W method.

[0087] (3) Details of Infusion Start Processing by Pump B (Step S415)

A procedure for infusion start processing by the pump B (step S415) will be described next. Fig. 7 is a flowchart showing a detailed procedure for infusion start processing by the pump B. Upon receiving a

notification indicating that cooperation can be establishment from the medical pump housing rack 200, the pump B starts the infusion start processing shown in Fig. 7.

[0088] In step S701, the pump B determines whether the medical pump housing rack 200 has input an infusion start instruction to the pump A, and determines whether it has received a notification indicating that an infusion start instruction has been input to the pump A. If the pump B determines in step S701 that it has received, from the medical pump housing rack 200, a notification indicating that an infusion start instruction has been input to the pump A, the process advances to step S702. If the medical pump housing rack 200 is not configured to notify the pump B of a changed flow rate setting every time it is changed, the pump B does not receive a flow rate setting change notification concerning the pump A. For this reason, the process advances to step S704 without executing the step S702.

[0089] In step S702, the pump B determines whether the pump A has changed the flow rate setting during infusion and the medical pump housing rack 200 has notified the changed flow rate setting. If the pump B determines in step S702 that the medical pump housing rack 200 has not notified the changed flow rate setting, the process advances to step S704 (as described above,

if step S702 is not executed, the process directly advances to step S704).

[0090] If the pump B determines in step S702 that the medical pump housing rack 200 has notified the changed flow rate setting, the process advances to step S703 to calculate and set a step flow rate or the like based on the notified flow rate setting (as described above, if step S702 is not executed, the process directly advances to step S704).

[0091] In step S704, the pump B determines whether it has received, from the medical pump housing rack 200, a notification indicating that cooperation has been established. If NO in step S704, the process returns to step S702 (note that if the medical pump housing rack 200 does not notify the pump B of a changed flow rate setting every time it is changed, the process returns to step S704).

[0092] If the pump B determines in step S704 that it has received a notification, the process advances to step S705 to start infusion (note that if the 200 does not notify the pump B of a changed flow rate setting every time it is changed, the pump B executes the processing in step S703 based on the received flow rate).

[0093] As is obvious from the above description, when monitoring infusion by the W method using a plurality of housed medical pumps,

· the medical pump housing rack according to this embodiment is configured to determine cooperation permission/inhibition with respect to the cooperation instructed by the user; and

· the medical pump housing rack is configured to define a cooperation establishment condition between the start of infusion by the pump A and the start of infusion by the pump B and cause the pump B to start infusion when the condition is satisfied.

[0094] As described above, the medical pump housing rack is configured to monitor various operations performed by the user on medical pumps which perform infusion by the W method. According to this embodiment, therefore, it is possible to reduce operation errors made by the user.

[0095] The present invention is not limited to the above-described embodiments, and various changes and modifications can be made within the spirit and scope of the present invention. Therefore, to apprise the public of the scope of the present invention, the following claims are made.

[0096] This application claims the benefit of Japanese Patent Application No. 2010-218978, filed September 29, 2010, which is hereby incorporated by reference herein in its entirety.

CLAIMS

1. A medical pump housing rack which houses a plurality of arranged medical pumps and is communicatively connected to the housed medical pumps, characterized by comprising:

cooperation permission/inhibition determination means for determining whether two predetermined medical pumps of the plurality of housed medical pumps are configured to operate in cooperation with each other, based on information indicating housing positions at which the two medical pumps are respectively housed and drug information set in each of the two medical pumps; and

cooperation permission notification transmission means for, if said cooperation permission/inhibition determination means determines that the two medical pumps are configured to operate in cooperation with each other, transmitting, to the two medical pumps, cooperation permission notifications for validating operation of issuing infusion start instructions for a drug to the two medical pumps.

2. The medical pump housing rack according to claim 1, characterized in that said cooperation permission/inhibition determination means determines that the two medical pumps are configured to operate in cooperation with each other, if housing positions at which the two medical pumps are respectively housed are

adjacent to each other and pieces of drug information set in the two medical pumps match.

3. The medical pump housing rack according to claim 2, characterized in that said cooperation permission/inhibition determination means identifies medical pumps, of the plurality of housed medical pumps, to which a user issues an instruction to operate in cooperation with each other, and determines whether the identified medical pumps are configured to operate in cooperation with each other.

4. The medical pump housing rack according to claim 3, characterized by further comprising cooperation start instruction transmission means for transmitting a cooperation start instruction transmitted from a starting medical pump, of the two medical pumps to which cooperation permission notifications are transmitted by said cooperation permission notification transmission means, which has started infusion first to a subsequent medical pump which starts infusion later,

wherein when said cooperation start instruction transmission means transmits the cooperation start instruction, the subsequent medical pump starts infusion.

5. The medical pump housing rack according to claim 4, characterized by further comprising flow rate setting transmission means for, upon receiving an instruction indicating that a flow rate setting during infusion

from the starting medical pump has been changed, transmitting the changed flow rate setting to the subsequent medical pump before the cooperation start instruction is transmitted from the starting medical pump,

wherein a flow rate setting in the subsequent medical pump is changed when said flow rate setting transmission means transmits the changed flow rate setting.

6. The medical pump housing rack according to claim 4, characterized by further comprising warning transmission means for transmitting a warning instruction to the subsequent medical pump if a user has not performed operation of issuing an infusion start instruction to the subsequent medical pump when the starting medical pump transmits the cooperation start instruction,

wherein said cooperation start instruction transmission means transmits the cooperation start instruction to the subsequent medical pump if the subsequent medical pump outputs a warning in response to transmission of a warning instruction from said warning transmission means, and the user performs operation of stopping output of the warning.

7. A control method for a medical pump housing rack which houses a plurality of arranged medical pumps and is communicatively connected to the housed medical

pumps, characterized by comprising:

a cooperation permission/inhibition determination step of determining whether two predetermined medical pumps of the plurality of housed medical pumps are configured to operate in cooperation with each other, based on information indicating housing positions at which the two medical pumps are respectively housed and drug information set in each of the two medical pumps; and

a cooperation permission notification transmission step of, if it is determined in the cooperation permission/inhibition determination step that the two medical pumps are configured to operate in cooperation with each other, transmitting, to the two medical pumps, cooperation permission notifications for validating operation of issuing infusion start instructions for a drug to the two medical pumps.

8. A program for causing a computer to execute each step in a control method defined in claim 7.