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Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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(54) Title: METHOD FOR SELECTING A PIPETTE TIP AND A DEVICE FOR IMPLEMENTATION

(57) Abstract: This invention relates to a method for selecting a plunger-cylinder tip of a pipette and a device for carrying out the method. In the method, the dose size is entered into the control electronics of the pipetting device; the dose size is stored in the control electronics; the amount of doses is entered; and on the basis of the dose size and the amount of doses, the control electronics indicates suitable available interchangeable components on the display.

Method for selecting a pipette tip and a device for implementation

This invention relates to a method for selecting a pipette tip according to the preamble of claim 1 and to a device for the implementation of the method.

Liquid dispensing systems are previously known wherein the functional parameters of an interchangeable component placed in its position for receiving liquid to be dispensed are entered by means of a keybord for programming the operation of the device. An infusion pump of aforementioned kind has been disclosed e.g. in US 4,529,401. However, said publication does not disclose selecting an interchangeable component.

Manual liquid dispensing in laboratories is usually performed with so-called air displacement pipettes which are easy and economic to use. However, there are situations in which the performance of an air displacement pipette is not sufficient, and in such a case a user selects a pipette to which a disposable piston-cylinder assembly can be connected. Typically, this occurs when using liquids having a high viscosity or high volatility. The pipettes provided with a disposable plunger-cylinder assembly are also especially suitable for so-called multiple dispensing which enables stepwise dispensing of a liquid from a syringe.

In using such interchangeable plunger-cylinder assemblies designed for use in mechanical pipettes, a user places an interchangeable component in its position, sets a parameter typically affecting the dispensing stroke and then checks in a separate table which volume said stroke will give with each type of pipette tip. The laboriousness of the use of such plunger-cylinder assemblies and separate tables will especially accentuate the advantages achievable by the method according to the present invention, such as easy manageability and the precision of dispensing parameters.

Subsequently, pipetting systems have been developed for the aforementioned situations enabling the identification of a mounted interchangeable component. In known pipetting systems, comprising means for identifying different tip types, as disclosed in patent specification FI 109337, also the interchangeable component has to be provided with identifying

means whereby, however, when selecting interchangeable components, i.e.tips, the user of the pipetting system must use specially made tips.

US 6,090,348 discloses a pipetting device providing for the use of tips of different sizes, selectable from an electronic menu during use. After the selection, the functional parameters of the program for the pipette are locked in accordance with the volume of the selected tip.

In conventional pipettes, the volumes are thus determined by pipette settings, and the tips of different sizes differ from each other in having tapers of different sizes. When using disposable plunger-cylinder assemblies, the fastening elements for different volumes are of the same size, and therefore, the risk of attaching a wrong plunger-cylinder assembly is very high.

An objective of the invention is thus also to provide a pipetting device wherein the selecting mechanism of an interchangeable component is arranged so that it does not require the use of a specially made tip, but gives a user the possibility to select a tip suitable for a particular pipetting task from a predetermined selection of tips.

This objective may be attained by using an electronic liquid dispenser or a liquid dispenser provided with an electronic control system for performing the method. Preferably, the basic construction of the liquid dispenser may be, for instance, of the same type as pipettes with an electronic tip remover in Biohit's *e*LINE series.

More precisely, in the method according to the invention, the size of a dose and the amount of said doses are entered in the order of choice; and thereafter the control system indicates an interchangeable component or the interchangeable components available for the relevant dose size and amount of doses. Preferably, the control system primarily indicates an optimal interchangeable component.

According to a preferred embodiment, a plurality of interchangeable component data are first entered (generally prior to the actual use situation), and thereafter those interchange-

able components which are not in use are excluded. Prior to use, the size of the dose to be dispensed is input, whereafter the amount of said doses is entered. In a preferred embodiment a broad selection of interchangeable components has been entered to the pipetting device in such a way that the user cannot have any influence thereon, but in advance he/she may deactivate from this selection those interchangeable components which are not available. Therefore, when suggesting interchangeable components suitable for each pipetting task, the control system only takes those interchangeable components, which in fact are available, into consideration.

Preferably, the method according to the invention can be carried out with an apparatus which is an electronically controlled pipetting device, comprising a body having a part for receiving an interchangeable component. The device further comprises electronic control means which control the operation of the pipette, as well as an implementing keyboard and a plunger actuator movable in the direction of the body for dispensing liquid to be pipetted. The device further comprises means for storing data entered into the device, said means preferably being a memory. The data entered to the device includes the dose sizes, the dose amounts as well as information on available interchangeable components. The available interchangeable components are pipette tips comprising a plunger and a cylinder, the measuring volume of which preferably varying between 0.1 and 50 ml.

In a preferred embodiment, the device further comprises electronically controlled locking means, by means of which a detachable interchangeable component may be attached or detached, and means for transferring the state of the locking means to the electronic control means, which preferably is a program. The dosing parameters and/or the type and/or the size of an interchangeable component can be entered into the electronic control means by means of the keyboard of the device.

The pipetting device preferably comprises a locking and detaching mechanism operating under the control system, by means of which the control system can detect the detachment of an interchangeable component.

An advantageous embodiment is also a device, which is an electronically controlled pipetting device comprising a body having a tip portion for receiving a detachable interchangeable component; electronic control means for controlling the operation of the pipette; an implementing keyboard, by means of which the dispensing parameters of an interchangeable component can be input to the electronic control means; a plunger actuator, movable in the direction of the body for dispensing liquid to be pipetted; an electronically controlled locking means adjustable in the pipette in the cross direction of the body for attaching or detaching an interchangeable component; a control means for controlling the movement of the locking means in a direction deviating from the longitudinal direction; and the movement of the plunger actuator can be continued in the longitudinal direction so that the continued longitudinal movement of the actuator may be converted into movement in a direction deviating from the longitudinal direction by means of the control means controlling the movement of the locking means, whereby an interchangeable component is removable preferably axially.

According to the invention, also a pipetting system can be provided, comprising an electronic pipetting device or a pipetting device provided with electronic control, to which pipetting device an interchangeable component is detachably attachable for receiving liquid to be pipetted, the interchangeable component being formed as a plunger-cylinder unit, the plunger of which being movable in the interchangeable component arranged in the pipetting device by means of a plunger actuator of the pipetting device with respect to the cylinder in connection with pipetting movement, for aspiring and discharging liquid to be pipetted, whereby different types of interchangeable components can be arranged in the pipetting device, whereby, however, one and the same relative position of the plunger and the cylinder is arranged for all interchangeable component types so that all interchangeable component types are connectable to the pipetting device in the same manner.

A practical example: A pipetting system, comprising a pipetting device provided with electronic control and having a body, and to which pipetting device an interchangeable component is detachably attachable for receiving liquid to be pipetted, said interchangeable component being formed as a plunger-cylinder unit, the plunger of which is movable in the interchangeable component arranged in the pipetting device by means of an plunger actua-

tor of the pipetting device with respect to the cylinder in connection with the movement of the pipetting for aspiring and discharging liquid to be pipetted, whereby several different types of interchangeable components can be arranged in the pipetting device, whereby, however, one and the same relative position of the plunger and the cylinder is arranged for all types.

An electronic pipette may be a hand-held, battery-operated, microprocessor-controlled pipette, comprising a body, which embeds a power supply means for a motor, a control means for controlling the motor, and a means for controlling the operations of the pipette, a display, a tip portion, the plunger of which being arranged reciprocably moveable in the cylinder chamber for changing the volume of the cylinder chamber, and means for converting the rotating movement of the motor into the movement of the plunger in the substantially longitudinal direction of the body of the pipette in the cylinder chamber. The means for controlling the operations of the pipette consist preferably, for instance, of a microprocessor, comprising, in addition to a central processing unit, at least a storage means both for permanent storing of data and/or programs and for temporary storing of data and/or programs as well as a means for connecting the microprocessor to means for controlling the display, to buttons and/or switch keys for controlling the operations, sensors for identifying the states of the controlling elements of the pipette as well as means for transferring the control signals received from the microprocessor to the control means of the motor. The data and programs stored in the storage means may be stored in the manufacturing stage of the pipette, or a user may store them during use of the pipette.

In a preferred embodiment, in using the pipetting device, a user selects a dispensing mode supporting the function (for instance, the d-mode which is functional in all eLINE Dispenser devices of Biohit and which is used for multiple dispensing). Thereafter the software requires a user (preferably by means of a message shown on the display) to enter the dose size. When the user has entered the dose size (for instance 10 µl) to the control electronics by means of the keyboard, the software requires the user (preferably by means of a message shown on the display) to input the amount of doses (for instance, 40). When the user has entered the amount of doses to the control electronics, the software suggests (preferably by means of a message shown on the display) a tip optimally suitable for the task in

question. The measuring volumes of the tips preferably vary between 1 µl and 50 µl. If there are several alternatives, it is possible to move between these alternatives on the display using the keyboard, and further to select an alternative of choice by means of the keyboard. The keyboard may preferably comprise a roll for facilitating moving on the display.

A user has the possibility to enter in advance the available tip selection to the memory of the pipetting device by means of the same software and keyboard, whereby the software can suggest (preferably by means of a message shown on the display) the available tip size alternatives by excluding those tip types not available for the relevant pipetting task. The pipetting task is determined by the dose size and the amount of doses.

Claims

1. A method for selecting an interchangeable component formed as a plunger-cylinder unit to be connected to a pipetting device provided with an electronic control system, **characterized** in that the method comprises the following stages in a selectable sequence:

- a user enters the dose size to the control system of the pipetting device;
- the user enters the amount of doses;

whereafter the control system indicates, on the basis of the said dose size and the said amount of doses, suitable interchangeable components from a previously stored selection of interchangeable components.

2. The method according to claim 1, **characterized** in that part of the stored selection of interchangeable components can be excluded from use.

3. The method according to claim 1, **characterized** in that the plunger in an interchangeable component arranged in the pipetting device is moved with respect to the cylinder by means of a plunger actuator, in connection with pipetting movement, for aspiring and discharging liquid to be pipetted, whereby different types of interchangeable components can be provided in the pipetting device, whereby one and the same relative position of the plunger and the cylinder is arranged for all types of interchangeable components.

4. The method according to claim 1, **characterized** in that the pipetting device comprises a locking and detaching mechanism operating under the control system, by means of which mechanism the control system can detect the detachment of an interchangeable component.

5. An electronically controlled pipetting device, comprising

- a body, having a tip portion, to which a detachable interchangeable component is receivable;
- an electronic control system which controls the operation of the pipette;
- an implementing keyboard;
- a plunger movable in the longitudinal direction of the body for dispensing liquid to be

pipetted;

- a display
- **characterized** in that it comprises means for storing the parameters of different interchangeable components formed as a plunger-cylinder unit in the electronic control system;
- the dose size and the amount of doses can be entered into the electronic control system by means of the keyboard.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2007/050226

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6090348 A (STEELE ET AL), 18 July 2000 (18.07.2000), column 2, line 28 - line 38; column 3, line 18 - column 4, line 2; column 5, line 22 - line 23, column 6, line 8 - line 11	1-5
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A	US 5505097 A (SUOVANIEMI ET AL), 9 April 1996 (09.04.1996), figure 1, abstract	5
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 June 2007	28 -06- 2007
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Erik Wiss/EK Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2007/050226

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 1-4
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Present claims 1-4 relate to a method defined by reference to a result to be achieved, namely that the pipetter system is

.../...

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Box II.2

able to choose a suitable pipette tip when the user has entered the preferred volume and number of aliquots. However, the claims fail to define how the system is supposed to accomplish these results. The claims are therefore considered to lack clarity (Article 6 PCT). This lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible.

Consequently, the search has been carried out for those parts of the claims which appear to be clear, supported and disclosed, namely those parts relating to a method of choosing a pipette tip using a computerised pipetter system.

International patent classification (IPC)
B01L 3/02 (2006.01)

Cited literature, if any, will be enclosed in paper form.

US	6090348	A	18/07/2000	EP	0864364	A 16/09/1998
				JP	10311781	A 24/11/1998
US	5505097	A	09/04/1996	CA	2101855	A 06/08/1992
				EP	0570423	A 24/11/1993
				FI	86969	B,C 31/07/1992
				FI	910548	A 31/07/1992
				HU	9302273	D 00/00/0000
				JP	3240374	B 17/12/2001
				JP	6504945	T 09/06/1994
				WO	9213638	A 20/08/1992