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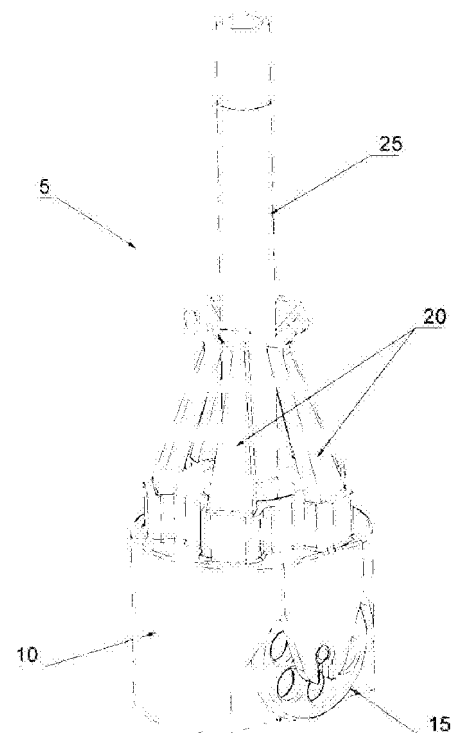
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Tube Carrier.

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The field of the present invention relates to sample tube carrier for automated analy/er systems for processing patient samples. The invention provides a sample carrier for automated analyzer systems, comprising a body with two wheels at opposite sides of the body for moving the sample carrier, a ferromagnetic core arranged with the body, wherein the sample carrier has no drive.

FIG. 1



TUBE CARRIER

DESCRIPTION

Field of the invention

[0001] The field of the present invention relates to sample tube carrier for automated analyzer systems for processing patient samples.

Brief description of the related art

[0002] Rack based loading systems for samples are used in automated analyzers like instruments of STRATEC® Biomedical AG. The samples are stored in tubes which are vertically inserted into a rack in a way that an ID codes of the tubes can be read-out. The racks vary regarding the number of sample tubes they can carry, in their geometry and size, the type of tube fixation within the rack as well as in rack ID labeling and empty position detection.

[0003] The user manually inserts sample racks into a sample loading bay of an automated analyzer, wherein the sample rack further comprises so-called guiding features like sample IDs that can be scanned during insertion of the rack. Once inserted and identified, the samples usually remain immobile at their position in the sample rack until they are processed and taken out by a user. The pipettor moves to reach specific samples.

[0004] An alternative approach to samples that are placed in a sample rack and a moving pipette represents a system that transport sample tubes to a processing place. Such a transport can be achieved by sample tubes that are placed in a rotating disc providing specific places for taking up samples.

[0005] European Patent Application EP 2 977 765 A1 discloses a sample container carrier for a laboratory sample distribution system having a cover above a magnet in order to suitably align and move the sample container carrier in the magnetic field. The document further relates to a laboratory sample distribution system having such a sample container carrier and to a laboratory automation system containing such a laboratory sample distribution system.

means in each case is designed in order to provide an associated container carrier with driving power.

[0009] An unsatisfying STAT (Short Turn Around Time) sample management is a side effect of such a rack-based handling, as at least one complete rack loading lane needs to be kept free all the time in case a single STAT sample must be loaded.

[0010] Another disadvantage is that a sample loading module occupies a lot of valuable space at the instrument front, whereas space in the rear of the instrument remains unused as it cannot be accessed by the user for loading and unloading samples.

[0011] The complete Sample Loading Unit needs to be accessible by the pipettor, which typically leads disadvantageously to larger pipettor travel ways, higher cost and spatial constraints.

[0012] The usual Sample Loading Unit is typically an area used by both, pipettor and user, which drives the needs for thorough risk assessment and appropriate risk mitigations to avoid hazardous interaction or unintended instrument damages.

[0013] Calibrators and control samples need a free sample rack so that an unoccupied rack lane has be introduced.

[0014] User handling of the sample racks has some ergonomic deficiencies like cumbersome loading or introducing of a long rack onto the guiding rails of the module or lack of stability of a rack when standing on a lab desk.

[0015] Sample vessels need to be manually oriented in the racks with their ID codes facing towards specific rack openings for safe and reliable reading.

[0016] Cleaning of the module base is complicated due to installed rack guiding features.

[0027] Still other aspects, features, and advantages of the present invention are readily apparent from the following detailed description, simply by illustrating a preferable embodiments and implementations. The present invention is also capable of other and different embodiments and its several details can be modified in various obvious respects, all without departing from the spirit and scope of the present invention. Accordingly, the drawings and descriptions are to be regarded as illustrative in nature, and not as restrictive. Additional objects and advantages of the invention will be set forth in part in the description which follows and in part will be obvious from the description, or may be learned by practice of the invention

Summary of the figures

[0024] For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following description and the accompanying drawings, it shows:

- FIG. 1 Passive transport carrier with sample tube
- FIG. 2 Top view onto passive transport carrier
- FIG. 3 Side view on passive transport carrier without sample tube
- FIG. 4 Bottom view on passive transport carrier
- FIG. 5 Sectional view into passive transport carrier
- FIG. 6 Magnetic simulations to visualize differences between coupled (left) and uncoupled state between passive transport carrier and handling system

Detailed description of the invention

[0028] The invention relates to a passive transport carrier for a single sample tube. The technical problem is solved by the features of the independent claim. The dependent claims refer to further embodiments of the invention.

[0029] Within the meaning of the present invention, passive in terms of a carrier means, that the carrier has no active drive components to accomplish the transport by itself. The carrier is a generic device to allow for integration in various OEM analyzers and their loading and transport concepts. It has an internal ferromagnetic core, so it can be moved by magnetic force of an external permanent magnet as part of the transport installation.

[0030] The terms carrier, sample carrier, transport carrier and passive transport carrier shall be understood as synonyms within the description of the present invention.

[0031] The carrier is equipped with two big wheels that support a low friction linear movement and allow for rotating the carrier around its vertical centre axis. The carrier further comprises RFID technology to carry and provide information about the carrier ID and type, the loaded tube and sample and additional information like e.g. priorities for handling, travel paths or destination. The carrier information and information about the patient sample may also be matched by the instrument software. This could be useful if the RFID Tag is not writable within the instrument.

[0032] The basic carrier allows for loading of sample tubes with a diameter of 10 – 16 mm. Different types of carriers like for paediatric tubes or for project specific solutions can be customized if needed in a specific analyzer. Sample tubes are inserted manually and can reliably identified without rotational alignment by the user. Basic tube heights up to 100 mm are supported, higher tubes can be inserted and fixed easily as the carrier does not limit tube heights.

[0033]

[0034] The carrier is intended to roll over flat surfaces inside the analyser, without having a drive that is arranged within the carrier.

[0035] A number of clamping springs center and fix a tube in a carrier of the present invention, wherein the number of clamping springs can vary between 3 and 5. Depending on number and geometry, the width of each clamping spring shall be limited to leave enough space between two springs to allow for reading a sample ID barcode labeled according to AUTO2 A2 specification (the appropriate specification for labeling ID codes on sample containers in the IVD field).

[0036] Unlike with commonly used sample racks, the user does not need to rotationally align the sample tubes when inserting them. Orientation between code and reader is established by either rotating the carrier or inspect turned-away codes by a multi-mirror approach.

[0037] Uncommon customer specific or project specific sample container geometries can be addressed by individual adapters or clamping mechanisms. Upcoming 2D- ID codes can be

supported by limiting the number of clamping springs, reducing their width or redesigning them in a way to open the field of view for a reader (e.g. camera) and the illumination.

[0038] As already mentioned, the carrier does not incorporate active drive components. Its movement is performed by applying a magnetic force between the carrier and the transport and handling system, which moves the passive sample carrier via this magnetic force coupling. The handling system and the passive transport carrier do not have direct contact. There is a planar traveling surface between them onto which the passive sample carrier does have three degrees of freedom to travel, two lateral ones (X /Y) on the planar surface and a rotational one around its center vertical axis.

[0039] To allow for a safe and reliable magnetic coupling between carrier and handling, the magnetic force must be adequately high. This force however contributes almost completely as normal force to the friction for the movement of the carrier on its travelling surface, which is the main reason, why the carrier uses two wheels for its movement and does not purely slide.

[0040] Both wheels are located on a virtual axis through the center of the passive transport carrier to ideally allow for a rotational movement. As bigger wheels easier pass little particles or other obstacles, the carrier shall contain the biggest possible wheels to fit in its cylindrical build body.

[0041] Each carrier contains a ferromagnetic core. It is not intended to implement permanent magnets in the passive sample carrier as their magnetic forces would attract, repel or in any other way influence other carrier in the analyzer as well as before, during and after loading and unloading. The U-shaped ferromagnetic core is a result of design and simulation iterations for best supporting lateral and rotational passive transport carrier moves.

[0042] The carrier could easily make uncontrolled and undesired moves and worst-case tip over and spill sample liquid out of the tubes they carry. This would be considered as a high-risk scenario as the spilled liquid may contaminate a user, the analyzer or the workplace.

[0043] As the carrier of the present invention can easily roll, it is mandatory to implement measures to set it still in certain positions as for example for identification, storage or pipetting. The different functions in these positions trigger different approaches to reduce some or all degrees of freedom of a carrier of the present invention. This is achieved by means of external

forces like friction, clamping, recessed seating or magnetic fixation as the carrier itself does not incorporate a fixation mechanism.

[0044] The carrier itself comprises an ID-tag at its bottom surface for storing information, like a RFID-tag. The ID tag can either be read-only or it can support read /write functionality, depending on the system it is used for.

[0045] The ID tag can support multiple functions like

- Allow for distinction between different passive transport carrier types
- Enable matching of patient sample ID and passive transport carrier I, which provides easy and valid sample ID reading at all relevant positions inside the analyzer
- Allow for allocation of routing options and for allocation of handling or processing preferences or priorities to a passive transport carrier
- Support for system reboot after blind start-up / energy loss, which makes identification of passive transport carrier easier

[0046] Each carrier needs to be sensed for presence during handling and transport as it is only coupled to the handling system via magnetic force. It has to be ensured that this coupling is not lost along the way and that the carrier follows the routed path of the handling system. A Hall-sensor chip can be located in the handling system or the passive transport carrier for sensing coupling of handling system and sample carrier.

[0047] In case that a carrier is coupled, a significant portion of the magnetic field of the permanent magnet inside the handling system is routed through the U-shaped ferromagnetic core of the carrier. In an uncoupled state this magnetic field routes differently through ambient and air.

[0048] FIG. 1 shows a passive transport carrier 5 with a body 10 and a wheel (not shown). On top of the body 10 are clamping 20 arranged for fixation of a sample tube 25. The number of clamps 20 may depend from the diameter of sample tube 25.

[0049] FIG. 2 shows a top view onto a passive transport carrier 5 with five clamps 20 for fixation of a sample tube 25.

[0050] FIG. 3 shows a side view on a passive transport carrier 5. It can be taken from FIG. 3 that the diameter of wheel 15 is spanning through more than the half-height of body 10. The wheel 15 is arranged between body 10 and outer plate 11 in a recess 12 on opposing sides of the body 10 as can be taken from FIG. 4.

[0051] FIG. 4 further shows an ID tag for storing information regarding the content of the sample tube or the path that the passive transport carrier has to go for appropriate processing of the sample.

[0052] FIG. 5 shows a sectional view of a passive transport carrier 5 with body 10, hidden wheel 15, plate 11 and clamps 20. The ferromagnetic core 35 is U-shaped and arranged in an upright position with its opening directed to the bottom of body 10 of passive transport carrier 5. The U-shaped magnet is arranged onto a base plate 40.

[0053] FIG. 6A and FIG. 6B show magnetic simulations to visualize differences between coupled (FIG. 6A) and uncoupled state (FIG. 6B) between passive transport carrier and handling system.

[0054] The U-shaped magnet of handling system 45 and a carrier 35 as well as the magnetic flux lines with coupled carrier 45 are shown in FIG. 6A. In FIG. 6B are the magnetic flux lines without coupled carrier 46 shown. The sensor position 50 for determining whether a carrier is indicated in FIG. 6B, which can be between the flanks of U-shaped magnet 45.

[0055] The foregoing description of the preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and modifications and variations are possible in light of the above teachings or may be acquired from practice of the invention. The embodiment was chosen and described in order to explain the principles of the invention and its practical application to enable one skilled in the art to utilize the invention in various embodiments as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto, and their equivalents. The entirety of each of the aforementioned documents is incorporated by reference herein.

Reference Numerals

- 5 passive transport carrier
- 10 body
- 11 outer plate
- 12 recess
- 15 wheel
- 20 clamp
- 25 sample tube
- 30 ID tag
- 35 U-shaped ferromagnetic core
- 40 base plate
- 45 magnetic flux lines with coupled carrier
- 46 magnetic flux lines without coupled carrier
- 50 sensor position

CLAIMS

1. A sample carrier for automated analyzer systems, comprising a body with two wheels at opposite sides of the body for moving the sample carrier, a ferromagnetic core arranged within the body, wherein the sample carrier has no active drive.
2. The sample carrier of claim 1, wherein the ferromagnetic core is U-shaped.
3. The sample carrier of claim 2, wherein the U-shaped ferromagnetic core is in an upright position with its opening directed to the bottom of the sample carrier.
4. The sample carrier of any one of claims 1 to 3, comprising clamps on top of its body for fixation of sample tubes.
5. The sample carrier of claim 4, comprising two to five clamps.
6. The sample carrier of claim 4 or 5, wherein the clamps have a length for fixation of sample tubes with a diameter of 10 to 16 mm and a height of maximal 100 mm.
7. The sample carrier of any one of claims 1 to 6, comprising ID tags at its bottom for storing information.
8. The sample carrier of any ones of claims 1 to 7, wherein the two wheels are arranged centrally on a virtual axis through the sample carrier.
9. The sample carrier of any one of claims 1 to 8, wherein the diameter of the wheels is larger than at least half of the height of the sample carrier body.
10. A system comprising a sample carrier according to any one of claims 1 to 9, a transporting surface onto which the passive transport carrier is moved, and a handling system arranged below the transporting surface.

1. Ein Probenträger für automatisierte Analysensysteme, umfassend einen Träger mit zwei Rädern an gegenüberliegenden Seiten des Trägers zum Bewegen des Probenträgers, wobei ein ferromagnetischer Kern in dem Träger angeordnet ist, wobei der Probenträger keinen Antrieb aufweist.
2. Der Probenträger nach Anspruch 1, wobei der ferromagnetische Kern U-förmig ist.
3. Der Probenträger nach Anspruch 2, wobei sich der U-förmige ferromagnetische Kern sich in einer aufrechten Position befindet und seine Öffnung zum Boden des Probenträgers gerichtet ist.
4. Der Probenträger nach einem der Ansprüche 1 bis 3, umfassend Klammern an der Oberseite des Trägers zur Fixierung von Probenröhrchen.
5. Der Probenträger nach Anspruch 4, mit zwei bis fünf Klemmen.
6. Der Probenträger nach Anspruch 4 oder 5, wobei die Klammern eine Länge zum Fixieren von Probenröhrchen mit einem Durchmesser von 10 bis 16 mm und einer Höhe von maximal 100 mm aufweisen.
7. Der Probenträger nach einem der Ansprüche 1 bis 6, der an seiner Unterseite ID-Etiketten zum Speichern von Informationen aufweist.
8. Der Probenträger nach einem der Ansprüche 1 bis 7, wobei die beiden Räder zentral auf einer virtuellen Achse durch den Probenträger angeordnet sind.
9. Der Probenträger nach einem der Ansprüche 1 bis 8, wobei der Durchmesser der Räder größer ist als mindestens die Hälfte der Höhe des Probenträgerkörpers.
10. Ein System umfassend einen Probenträger nach einem der Ansprüche 1 bis 9, eine Transportfläche, auf welcher der Transportträger bewegt wird und ein Handhabungssystem, welches unterhalb der Transportfläche angeordnet ist.

FIG. 1

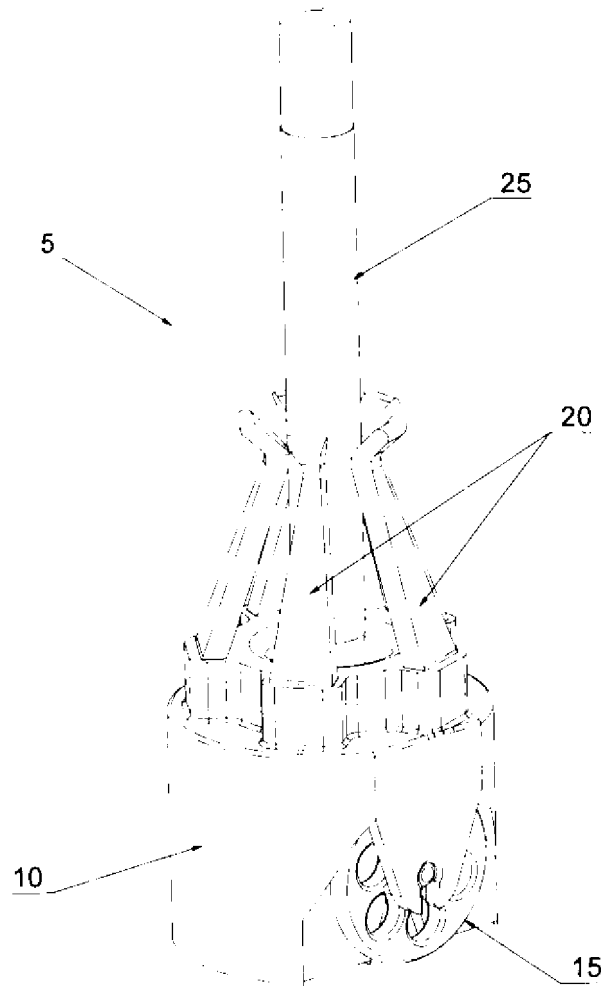


FIG. 2

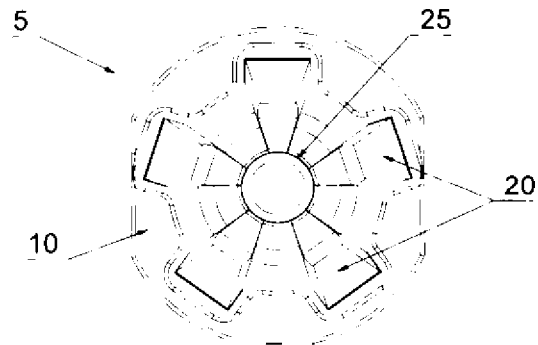


FIG. 3

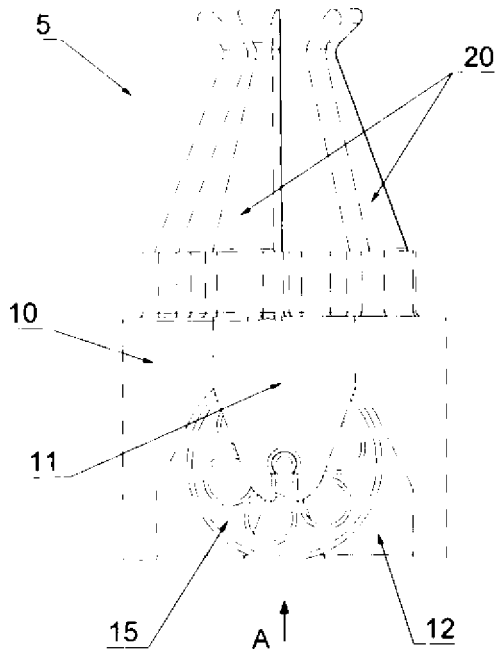


FIG. 4

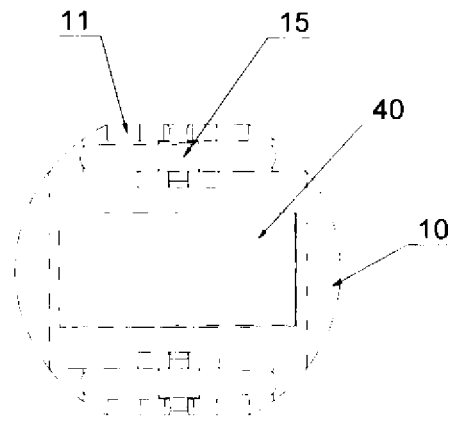


FIG. 5

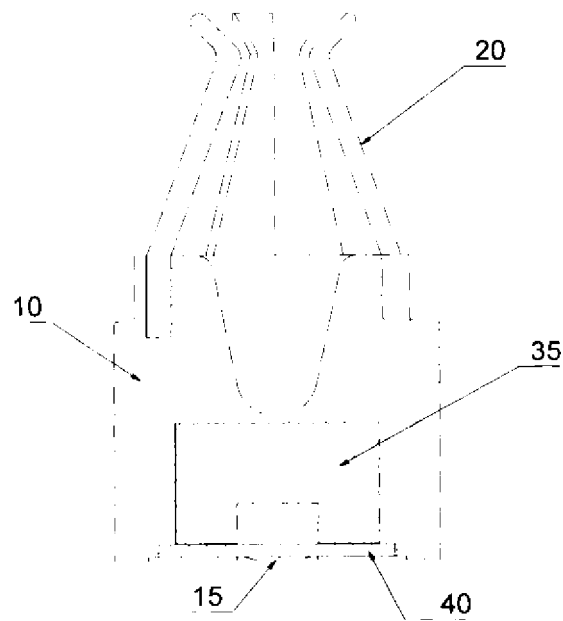


FIG. 6A

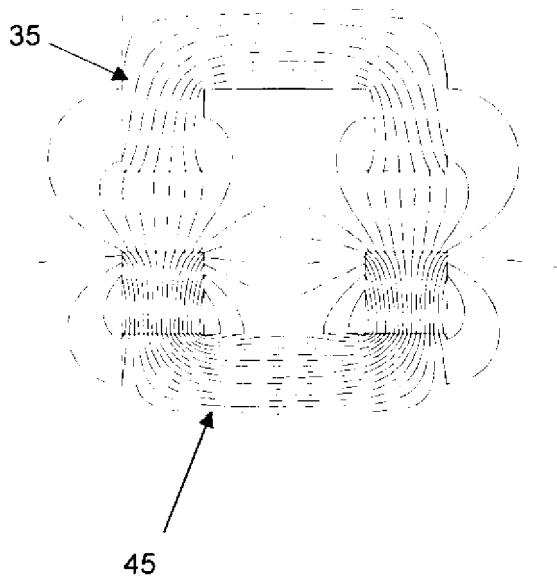


FIG. 6B

