



(51) International Patent Classification:
B01L 3/00 (2006.01) *C12N 1/00* (2006.01)
G01N 33/543 (2006.01)

(21) International Application Number:
PCT/IL2010/000192

(22) International Filing Date:
9 March 2010 (09.03.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/162,448 23 March 2009 (23.03.2009) US

(71) Applicant (for all designated States except US):
RAMOT AT TEL-AVIV UNIVERSITY LTD. [IL/IL];
Tel Aviv University Campus, The Senate Building,
Floor-1, P.O. Box 39296, 61392 Tel Aviv (IL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **STERER, Nir**
[IL/IL]; 16 Ya'acov Dori Street, 45314 Hod Hasharon
(IL). **ROSENBERG-NEVO, Melvyn** [IL/IL]; 34 Smadar
Street, 52596 Ramat-Gan (IL).

(74) Agent: **REINHOLD COHN AND PARTNERS**; P.O.
Box 13239, 61131 Tel Aviv (IL).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,
KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD,
ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,
NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD,
SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ,
TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: ASSAY DEVICE AND METHOD

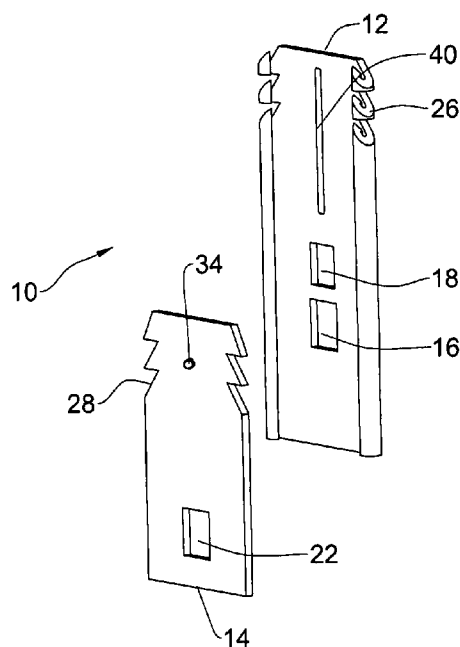


Fig. 2C

(57) Abstract: An assay device for detection of at least one analyte in a sample, the device comprising a housing and a carriage displaceable with respect to one another and comprising at least one sample assay array. One of the housing and the carriage comprises a sample receiving well and the other of the housing and the carriage comprises a sample introducing opening and a reagent agent location holding a reagent agent. The device further comprises at least two operative positions: a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location.



Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

ASSAY DEVICE AND METHOD

FIELD OF THE INVENTION

This invention relates to a simple and compact, disposable assay protective device and a method for using same for detection of an analyte or determining its concentration in a sample.

BACKGROUND OF THE INVENTION

Biological and chemical reaction devices have already been proposed, with the aim of simplifying the work of laboratories and individuals, and preventing the risks of contamination and inaccurate assaying.

for example, WO9313856 discloses an assay apparatus comprises a first assay zone constituted by a foam pad on a first solid support component constituted by a plastics card having a channel on one face thereof bordered by undercut walls receiving a plastics slide as a second solid support component having as a second assay zone a window. The support components fit together for relative sliding movement such that said zones are slidable with respect to one another from a first position in which said zones are separated from one another to a position in which said zones are brought into mutual contact by sliding motion. An antibody may be bound to the foam pad. An enzyme antibody conjugate may be unbound on the pad. An assay reagent which takes part in an observable reaction with the conjugate or a species to be assayed is present beneath window.

A different arrangement is disclosed in US patent 4,769,333 directed to a personal, disposable hand held diagnostic kit having a specimen support member such as a membrane, wafer or the like including a plurality of liquid receptacles with means for applying the liquids to said support member in sequence for relatively immediate observation of reaction and ultimate diagnosis.

- 2 -

SUMMARY OF THE INVENTION

The present invention is concerned with a simple to use and fool-safe assay device. The device is configured as a disposable and substantially cheap device, yet safe in operation, i.e. with no or substantially little risk of contamination.

According to the present invention there is provided an assay device for detection of at least one analyte in a sample, the device comprising a housing and a carriage displaceable with respect to one another and comprising at least one sample assay array, wherein one of said housing and said carriage comprises a sample receiving well and the other of said housing and said carriage comprises a sample introducing opening and a reagent agent location holding a reagent agent; the device comprising at least two operative positions: a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location.

According to one particular example, the device comprises three operative positions: an initial, closed position wherein each of the sample receiving well and the reagent agent location is sealingly concealed, a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location.

According to another of its aspects the invention there is concerned with an assay method for detection of an analyte or determining its concentration in a sample, the method comprising:

- (a) obtaining an assay device comprising a housing and a carriage displaceable with respect to one another and comprising at least one sample assay array, wherein one of said housing and said carriage comprises a sample receiving well and the other of said housing and said carriage comprises a sample introducing opening and a reagent agent location holding a reagent agent; the device comprising at least two operative positions: a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location;
- (b) introducing the sample through the sample introducing opening into the sample receiving well;

- 3 -

- (c) manipulating the device into the assay position for reaction to take place between the sample and the reagent agent;
- (d) observing the result of the interaction between sample and reagent agent.

According to a modification, the device comprises three operative positions: an initial, closed position wherein each of the sample receiving well and the reagent agent location is sealingly concealed, a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location. In this case the method comprises a further step before step (b) above, namely manipulating the device into the sample introducing position.

Where the device comprises at least two sample assay arrays and wherein steps b) to e) are carried out for each of the sample assay arrays

Any one or more of the following configurations and examples may be used in accordance with modifications of the invention:

- each sample assay array comprises at least one of a separate sample receiving well and a reagent agent location.
- two or more sample assay arrays share at least one of sample receiving well and a reagent agent location.
- the housing and the carriage are rotatably slidable, wherein the sample receiving well, the sample introducing opening and the reagent agent location of a sample assay array are equi-radially disposed.
- two or more equi-radially disposed sample assay arrays are provided, wherein rotation of one of the housing and the carriage in one direction manipulates a first sample assay array and rotation in an opposite direction manipulates a second sample assay array.
- two or more sample assay arrays are provided, each of which disposed about a diverse radii.
- the housing and the carriage are coaxial cylinders rotatably slidable, wherein the sample receiving well, the sample introducing opening and the reagent agent location of a sample assay array are equi-axially disposed in the housing and carriage.
- the housing and the carriage are linearly slidable, wherein the sample receiving well, the sample introducing opening and the reagent agent location of a sample assay array are linearly disposed.

- 4 -

- the device comprises at least two sample assay arrays parallelly disposed along the housing and carriage.
- one of the housing and the carriage is formed with longitudinal slots for sliding engagement with the other of housing and carriage.
- a locking arrangement is provided such that the carriage is displaced with respect to the housing between three distinct positions.
 - the locking arrangement is a one-way displacing ratchet mechanism.
 - a see-through window is provided over the reagent agent location.
 - the see-through window is covered by a removable light shield so as to prevent exposure of the reagent agent to light prior to use.
 - the carriage does not project from the housing at any of the three positions.
 - the reagent agent location remains unexposed at any of the three positions.
 - the sample receiving well is unexposed at the initial, closed position.
 - a visual indicator is provided to indicate a respective position of the device.
 - the reagent agent is suited for detecting conditions of oral malodor.
 - a motion restricting arrangement is provided for restricting displacement of the carriage and housing between only said three operative positions. According to a particular design, the motion restricting arrangement comprises a projection from a surface of one of the housing and carriage slidably received within a groove formed in a flush mating surface of the other of said housing and carriage.

The device of the present invention may be utilized for detecting in a sample of human or animal origin the presence or absence of a single or multiple analyte. In order to detect and/or analyze various bodily fluids such as saliva, blood, urine, semen, feces, vaginal secretion and other, the device is provided with a reagent membrane provided at the reagent agent location. Such a membrane may contain for example a dry chemistry reagent mixture, that is, a mixture in which the wet chemistries are imbibed into an absorbent or bibulous medium, dried, and later reconstituted by fluid from the test sample. A transparent, see-through layer is provided over the reagent membrane facilitating any changes in color or texture.

The indicating reagent mixture must be capable of detecting the presence of an analyte in a sample. The mixture may comprise for example various reagents and/or

- 5 -

assays for detecting the analyte and an indicator, both impregnated in the membrane matrix forming the reagent layer.

A portion of the reagent membrane may further be provided with a control substance to act as a quality control material to check that the device is functioning correctly. According to another example, the reagent membrane may be a multi-analyte detection system such that the membrane is divided to several section each of which is impregnated with a different reagent and/or indicator.

According to one example the indicator changes color, depending on the presence or concentration of a particular analyte in a biological sample applied to the membrane. The reaction on the membrane may for example be read visually by reference to a color standard or colorimetrically by instrument calibrated or programmed to detect a certain color.

Different reagents may be used to determine the content of the sample and/or analyte. The reagent layer may be impregnated with an assay for detecting helicobacteria, volatile sulfur compounds (VSCs), such as hydrogen sulfide, methyl mercaptan, dimethyl disulfide, and dimethyl sulfide, polyamines, such as putrescine and cadaverine associated with halitosis and present in a saliva; rates of electrolytes, enzymes, various bacteria species present in a saliva; hormones, protein, ketones, albumin or glucose in urine; such membrane may also be used to test for cholesterol, triglycerides, calcium or albumin in whole blood and may be used to detect for example presence of semen, saliva, blood, urine, perspiration, vaginal secretion and other body fluids in a sample.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, examples will now be described, by way of several non-limiting examples only, with reference to the accompanying drawings, in which:

Figs. 1A to 1C illustrate an assay device according to a first configuration of the present invention at its closed position, sample introducing and assay position, respectively;

Figs. 2A and 2B are front and rear respective isometric views of the device seen in Figs. 1;

- 6 -

Fig. 2C is an exploded isometric view of the device seen in Figs. 1;

Figs. 3A to 3C are schematic longitudinal sections along lines III-III in Figs. 1A to 1C, respectively;

Figs. 4A to 4C illustrate an assay device according to a second configuration of the present invention, at its closed position, sample introducing and assay position, respectively;

Figs. 5A; 5B, 6A; 6B and 7A; 7B are schematic sectioned views taken along lines I-I and II-II

Fig. 8 is a schematic top view of an assay device according to a third configuration of the invention, at its closed position;

Figs. 9A and 9B are schematic top views of the device of Fig. 8 at a first sample introducing and first assay position, respectively;

Figs. 10A and 10B are schematic top views of the device of Fig. 8 at a second sample introducing and second assay position, respectively;

Figs. 11A to 11C illustrate an assay device according to a fourth configuration of the present invention, at its closed position, sample introducing and assay position, respectively;

Figs 12A to 12C illustrate an assay device according to a fifth configuration of the present invention, at its closed position, sample introducing and assay position, respectively; and

Figs. 13A and 13B are exploded isometric views of assay devices according to yet other examples of the present invention.

DETAILED DESCRIPTION OF EXAMPLES

Attention is first directed to Figs. 1-3 directed to an assay device in accordance with a first example of the present invention generally designated **10** composed two principle elements, namely a housing **12** and a carriage **14** axially slidingly displaceable with respect to one another as can be appreciated from Figs. 1A – 1C and the respective side schematic illustrations disclosed in Figs. 3A-3C.

The housing **10** is formed with a sample-introducing opening **16** and a reagent agent location **18** in the form of a depression fitted with a reagent agent as will be

- 7 -

discussed hereinafter in further detail. The reagent agent location is fitted with a see-through window **20** (best seen in figs. 3A-3C).

The carriage **14** is fitted with a sample-receiving well **22** in the form of a cavity, the arrangement being such that said sample-introducing opening **16**, reagent agent location **18** and sample-receiving well constitute together a sample assembly array coaxially aligned as can best seen in Figs. 1A-1C.

The housing **12** is longer than the carriage **14** and is formed at its distal end with a plurality of radially inwardly projecting saw-like teeth projecting towards one another at both sides of the housing **12** whilst the carriage **14** is fitted with an inverted set of saw-like teeth **28** radially projecting outwardly whereby the housing **12** and the carriage **14** are slidingly displaceable with respect to one another in one direction only, as exemplified in Figs. 1A-1C, between three distinct positions namely, an initial, closed position (Figs. 1A and 3A), a sample-introducing position (Figs. 1B and 3B) and an assay position (Figs. 1C and 3C).

As seen, at the closed position the opening **16** extends intermediate the reagent agent location **18** and the sample-receiving well **22**, whilst the two latter are sealingly concealed namely unexposed to any sort of contamination. Upon sliding displacement of the carriage **14** in direction of arrow **30** the sample-receiving well **22** co-extends below the sample-introducing opening **16**, allowing for introducing of a sample into the well **22** through the opening **16**. Upon further displacement of the carriage **14** in direction of arrow **32** the sample-receiving well **22** now co-extends with the reagent agent location **18** whereby the sample contained within the sample-receiving well **18** comes into contact with the reagent provided at the reagent agent location **18**.

Depending on the type of assay performed, the reagent contained within the reagent agent location **18** will change its color to be viewed through the see-through window **20**, indicative of an analyte in the sample.

The device is a disposable device, not intended for secondary use. Even more so, the arrangement is such that the pair of housing **12** and carriage **14** are not detachable from one another (i.e. the carriage **14** is slidably displaceable only between its three distinct positions disclosed above, wherein detachment of the carriage **14** from the housing **12** is prevented, e.g. by means of an upwardly projecting pin **34** projecting from an upper surface **36** of carriage **14**, said pin being slideably displaceable within a longitudinal groove **40** formed in housing **12**, thus preventing this assembly or exposure

- 8 -

of the sample/reagent agent, so as to minimize risk of hazardous or environmental contamination). It is also noticed that the carriage **14** is slideable between the three distinct positions mentioned above, however it never projects between either end of the housing **12**.

In some cases the reagent agent may be sensitive to light and for that purpose a see-through window is covered by a removable light shield so as to prevent exposure of the reagent agent to light prior to use. The removable light shield according to one example is a removable sticker and according to another example is a sliding cover displaceable over the top surface of the housing between a concealing position in which the window is covered and will thus prevent light from reaching the reagent agent, and an open position in which the window is exposed for visualizing the reagent agent. Alternatively, the see-through window is formed at carriage at the bottom surface of the sample-receiving well, such that the reagent agent is exposed only once the carriage is displaced into the assay position.

Whilst the device and method referred to in connection with figures 1 to 3 make reference to a device manipulable between three operative positions, it is realized that other examples are possible with a device manipulable between only two operative positions, namely a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location. Thus, the device lacks the first operative position in which the sample receiving well is sealingly concealed. This applies also to the remaining examples as discussed herein after in connection with figures 4 to 13.

Turning now to Figs. 4-7 there is illustrated a second example of an assay device in accordance with the present invention generally designated **50** and composed of a disk-like housing **52** and disk-like house **54** coaxially pivoted about a rotation axis A, the two discs having flushing surfaces. The arrangement is such that a single sample array is provided, wherein the housing **52** is formed with a reagent agent location **56** sealingly covered with a see-through **57** (best seen in Figs. 5A, 6A and 7A), and a sample introducing opening **58** (Figs. 5B, 6B and 7B). Likewise the previous example, carriage **54** is fitted with a sample receiving well **58** (seen in Figs. 5A, 6B and 7A, and superimposed in Figs. 4A-4C, illustrated by dashed lines for sake of clarity). The arrangement is such that a top surface **66** of the carriage **54** bear flush against a bottom

- 9 -

surface **68** of the housing **52** in a slidably rotatable about the common axis of rotation **A**, wherein the reagent agent location **56** the sample introducing opening **58** and the sample receiving well **62** co-axially radially extend and are substantially equal size such that the sample receiving well **62** is displaceable between the three distinct positions namely an initial, closed position wherein the sample receiving well **62** and the reagent agent location **56** are sealingly concealed (Figs. 4A, 5A and 5B), a second, sample introducing position wherein the sample receiving well **62** coincides with the sample introducing opening **58** (Figs. 4B, 6A and 6B) and a third, assay position, wherein the sample receiving well **62** coincides with the reagent agent location **56** (Figs. 4C, 7A and 7B).

It is appreciated that in the examples of Figs. 4-7 the carriage **54** is displaceable in direction of arrow **72** (Figs. 4A and 4B between the three distinct positions as disclosed above).

The carriage **54** is designed for uni-directional rotation (in a counterclockwise direction in the present example) by means of a saw-like tooth arrangement as previously discussed, wherein a first set of teeth **72** projects from surface **68** of the housing **52** and a second set of teeth **74** projects from the surface **56** of carriage **54** each set of teeth **76** and **74** being equi-radially disposed (best seen in Figs. 4A-4C), said teeth being inclined in opposing fashions so as to provide sliding rotational displacement in one direction only.

Furthermore, the carriage **54** is formed with a pin **78** projecting from its top surface **66** and slidably received within an arced groove **80** formed at the bottom surface **68** of the housing **52** whereby rotational displacement of the carriage **54** without the housing **52** is facilitated only between said three distinct positions wherein once rotated in said clockwise direction of arrow **72** will not permit rotation in a backward direction whereby the sample received within sample receiving well **62** and the reagent agent location **56** remain unexposed also after use. It is thus appreciated that the device illustrated in connection with the second example is also a one-time disposable article.

The example illustrated in this Figs. 8-10 discloses a different configuration of an assay device in accordance with the present invention, generally designated **90** principally formed with similar elements as disclosed in connection with the second example disclosed above in connection with Figs. 4-7, however differing in that it comprises two sample assay arrays.

- 10 -

In the present example, the carriage is formed with a single sample-receiving well **94** (for sake of illustration illustrated by dashed lines) whilst the housing **96** is formed with a first sample-receiving well **98** and a first reagent agent location **100** extending on a common radii as the sample-receiving well **94** and further comprising a second sample-receiving well **102** and a second reagent agent location **104** also extending on the same radii as the sample-receiving well **94**.

The arrangement is such that the carriage is slidably rotatable about the housing **96** in both directions as illustrated by arrowed line **108**.

Other features of the assay device are substantially similar to those disclosed in connection with the previous example as illustrated in Figs. 4-7.

In this particular case, each sample assay array may comprise a different reagent agent within the reagent agent location **100** and **104**.

Accordingly, when it is desired to expose the sample to a first reagent agent located within reagent agent location **100**, the carriage is rotated in a counterclock direction of arrow **112** (Fig. 9A) whereby the sample-receiving well co-extends with the sample-introducing opening **98** to facilitate introducing of a sample into the sample-receiving well **94**. Further rotation of the carriage in direction of arrow **114** (Fig. 9B) entails engagement of the sample contained in the sample-receiving well **94** with the reagent agent provided within the reagent agent location **100** whereby a reaction takes place to be viewed through the viewing window.

Likewise, if it is desired to expose the sample to a different reagent agent contained within reagent agent location **104**, the carriage is rotated in a clockwise direction of arrow **116** (Fig. 10A) whereby the sample receiving well **94** coincides with the sample introducing opening **102** to facilitate introducing the sample into the sample-receiving well **102**. Further rotation of the carriage in direction of arrow **118** (Fig. 10B) entails contact of the sample with the reagent agent contained within the reagent agent location **104** to provide a second indication viewable through the appropriate window of the second reagent agent location **104**.

Like in previous examples disclosed hereinbefore, the sample-receiving wells and the reagent agent locations of both the sample assay arrays remain concealed at their respective positions to prevent contamination.

A fourth example is illustrated in Figs. 11A - 11C which is substantially similar to the second example of Figs. 4 - 7 and third example of Figs. 8-10 wherein a assay

- 11 -

device **120** comprises two sample assay arrays **122** and **124** wherein the carriage is fitted with a first sample-receiving well **126** corresponding with the first sample assay array **122**, and a second sample-receiving well **128** corresponding with the second sample assay array **124**, said sample-receiving wells **126** and **128** extending along the same radii line however at different distances from the center **a**. For sake of clarity, said sample-receiving wells **126** and **128** are illustrated by dashed lines. Likewise, the first sample assay array **122** comprises a first sample introducing opening **132** and a first reagent agent location **134** co-radially extending with the first sample receiving well **126**, and a second sample introducing opening **138** and a second reagent agent location **140** extending on the same radii as of the second sample receiving well **128** of the second sample assay array **124**.

Each of the reagent agent locations **134** and **140** of the first and second sample assay array **122** and **124** respectively may hold a reagent agent dedicated for a particular analytical test or may hold the same reagent agent wherein different samples are introduced into the respective sample receiving wells **126** and **128**.

The carriage is displaceable in a counterclockwise direction for initial, closed position (Fig. 11A) into the second sample-introducing position (Fig. 11B) and then further in a counterclockwise direction of arrow **146** into the assay position with both sample receiving wells **126** and **128** co-extend with the respective reagent agent locations **134** and **140** wherein two analyt tests are carried out simultaneously.

With further attention now directed to Figs. 12A -12C there is illustrated a fifth example of an assay device of the present invention generally designated **160** resembling the first example of Figs. 1-3, however comprising two parallelly extending sample assay arrays **162** and **164**. The first sample assay array comprises a first sample receiving well **168**, illustrated by dashed lines, formed on the carriage **170**. A first sample introducing opening **178** and a first reagent agent location **182** are formed respectively, on the housing **184** linearly aligned with said first sample receiving well **168**. The second sample assay array **164** is composed of a second sample receiving well **188** formed on the carriage **170** and a sample introducing opening **190** and a reagent agent location **192** are formed on the housing **184**, linearly aligned with said second sample receiving well **188** of the second sample assay array **164**.

The assay device **160** is displaceable between three operative positions namely and initial, closed position (Fig. 12A) wherein both sample receiving wells **168** and **188**

- 12 -

and both reagent agent locations **182** and **192** are sealingly concealed. Upon sliding displacement of the carriage **170** in direction of arrow **194** (Fig. 12B) both the sample receiving wells **168** and **188** coincide with the respective introducing openings **178** and **190** to allow introducing of a sample therein. Upon further displacement of the carriage in same direction of arrow **194** the sample receiving wells **168** and **188** coincide with both the reagent agent locations **182** and **192** of both sample assay arrays **162** and **164** respectively, wherein a reaction with the respective samples and the reagent agents contained within the reagent agent locations take place to be viewed through the appropriate openings.

The assay device **160** is fitted with the same features as of the first example namely being a one time disposable device wherein the carriage is slideable in one direction only and will not slide beyond its three respective positions.

Yet another example of an assay device according to the present example is illustrated in Figs. 13A and 13B disclosing a cylindrical structure. The device **200** comprises a cylindrical housing **202** coaxially receiving an inner carriage cylinder **204** which like in connection with the previous example is fitted with a one-way rotation arrangement for rotational displacement with respect to one another in a predetermined direction only as indicated by arrow **208**. The housing **202** is fitted with a sample-introducing opening **210** and a reagent agent location **212** as discussed herein above. The reagent agent location is fitted with a see-through window.

The carriage **204** is fitted with a sample-receiving well **222** in the form of a cavity, the arrangement being such that said sample-introducing opening **210**, reagent agent location **212** and sample-receiving well **222** constitute together a sample assembly **215**. The housing **202** and the carriage **204** are coaxially disposed about axis **A** and wherein the sample-introducing opening **210**, reagent agent location **212** and sample-receiving well **222** are equi-axially disposed about the axis **A**.

Rotating the housing **202** in direction of arrow **208** displaces the device between the three distinct positions as discussed above, namely a closed position wherein each of the sample receiving well **222** and the reagent agent location **212** is sealingly concealed, a sample introducing position wherein the sample receiving well **222** and the sample introducing opening coincide **210**, and an assay position wherein the sample receiving well **222** coincides with the reagent agent location **212**.

- 13 -

The example of Fig. 13B is substantially similar to the example of Fig. 13A with the exception that two sample assemblies **225A** and **225B** are provided, each comprising a sample-receiving well **230A** and **230B** in the form of a cavity formed in the inner cylinder **232**, a said sample-introducing opening **238A** and **238B** and a reagent location **240A** and **240B** formed in the housing **246**.

It is noted that components of each of the two sample assemblies **225A** and **225B** are equi-axially disposed about the axis **A**.

Other features of the devices of Figures 13A and 13B are substantially similar to those disclosed herein above in connection with the previous examples.

Those skilled in the art to which this invention pertains will readily appreciate that numerous changes, variations, and modifications can be made without departing from the scope of the invention, *Mutatis Mutandis*.

- 14 -

CLAIMS:

1. An assay device for detection of at least one analyte in a sample, the device comprising a housing and a carriage displaceable with respect to one another and comprising at least one sample assay array, wherein one of said housing and said carriage comprises a sample receiving well and the other of said housing and said carriage comprises a sample introducing opening and a reagent agent location holding a reagent agent; the device comprising at least two operative positions: a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location.
2. An assay device according to claim 1, comprising three operative positions: an initial, closed position wherein each of the sample receiving well and the reagent agent location is sealingly concealed, a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location.
3. An assay device according to claim 1, wherein each sample assay array comprises at least one of a separate sample receiving well and a reagent agent location.
4. An assay device according to claim 3, wherein two or more sample assay arrays share at least one of sample receiving well and a reagent agent location.
5. An assay device according to claim 1, wherein the housing and the carriage are rotatably slidable, wherein the sample receiving well, the sample introducing opening and the reagent agent location of a sample assay array are equi-radially disposed.
6. An assay device according to claim 5, comprising two or more equi-radially disposed sample assay array, wherein rotation of one of the housing and the carriage in one direction manipulates a first sample assay array and rotation in an opposite direction manipulates a second sample assay array.
7. An assay device according to claim 5, comprising two or more sample assay arrays each of which disposed about a diverse radii.
8. An assay device according to claim 1, wherein the housing and the carriage are coaxial cylinders rotatably slidable, wherein the sample receiving well, the sample introducing opening and the reagent agent location of a sample assay array are equi-axially disposed in the housing and carriage.

- 15 -

9. An assay device according to claim 1, wherein the housing and the carriage are linearly slidable, wherein the sample receiving well, the sample introducing opening and the reagent agent location of a sample assay array are linearly disposed.
10. An assay device according to claim 9, comprising at least two sample assay arrays parallelly disposed along the housing and carriage.
11. An assay device according to claim 10, wherein one of the housing and the carriage is formed with longitudinal slots for sliding engagement with the other of housing and carriage.
12. An assay device according to claim 10, wherein a locking arrangement is provided such that the carriage is displaced with respect to the housing between three distinct positions.
13. An assay device according to claim 12, wherein the locking arrangement is a one-way displacing ratchet mechanism.
14. An assay device according to claim 1, wherein a see-through window is provided over the reagent agent location.
15. An assay device according to claim 14, wherein the see-through window is covered by a removable light shield so as to prevent exposure of the reagent agent to light prior to use.
16. An assay device according to claim 1, wherein the carriage does not project from the housing at any of the three positions.
17. An assay device according to claim 1, wherein the reagent agent location remains unexposed at any of the three positions.
18. An assay device according to claim 1, wherein the sample receiving well is unexposed at the initial, closed position.
19. An assay device according to claim 1, wherein a visual indicator is provided to indicate a respective position of the device.
20. An assay device according to claim 1, wherein a motion restricting arrangement is provided for restricting displacement of the carriage and housing between only said three operative positions.
21. An assay device according to claim 18, wherein the motion restricting arrangement comprises a projection from a surface of one of the housing and carriage slidably received within a groove formed in a flush mating surface of the other of said housing and carriage.

- 16 -

22. An assay device according to claim 1, wherein the reagent agent is suited for detecting conditions of oral malodor.

23. An assay method for detection of an analyte or determining its concentration in a sample, the method comprising:

- (a) obtaining an assay device comprising a housing and a carriage displaceable with respect to one another and comprising at least one sample assay array, wherein one of said housing and said carriage comprises a sample receiving well and the other of said housing and said carriage comprises a sample introducing opening and a reagent agent location holding a reagent agent; the device comprising at least two operative positions: a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location;
- (b) introducing the sample through the sample introducing opening into the sample receiving well;
- (c) manipulating the device into the assay position for reaction to take place between the sample and the reagent agent;
- (d) observing the result of the interaction between sample and reagent agent.

24. A method according to claim 23, wherein the device comprises three operative positions: an initial, closed position wherein each of the sample receiving well and the reagent agent location is sealingly concealed, a sample introducing position wherein the sample receiving well and the sample introducing opening coincide, and an assay position wherein the sample receiving well coincides with the reagent agent location and wherein a further step before step (b), namely manipulating the device into the sample introducing position.

25. A method according to claim 23, wherein the device comprises at least two sample assay arrays and wherein steps b) to d) are carried out for each of the sample assay arrays.

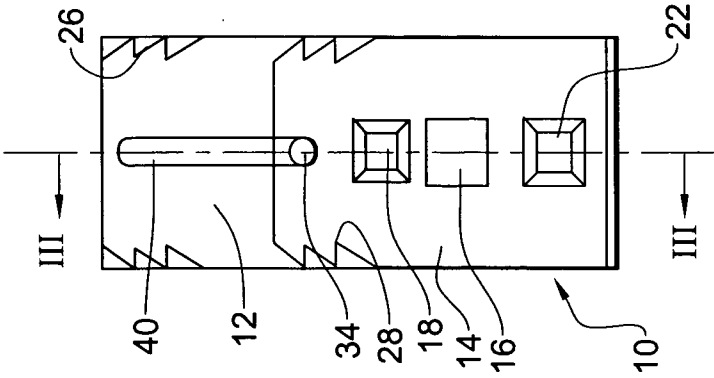


Fig. 1A

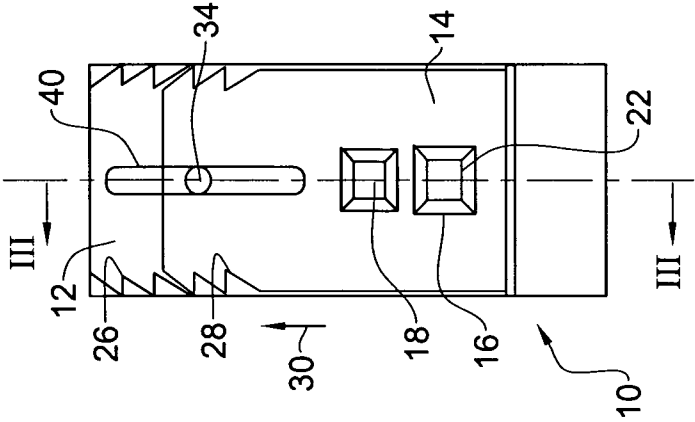


Fig. 1B

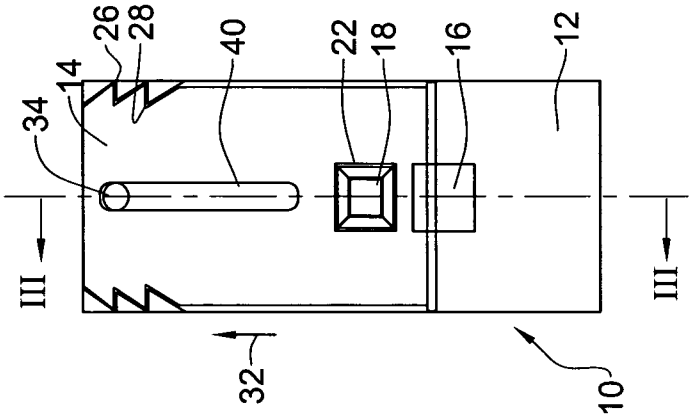


Fig. 1C

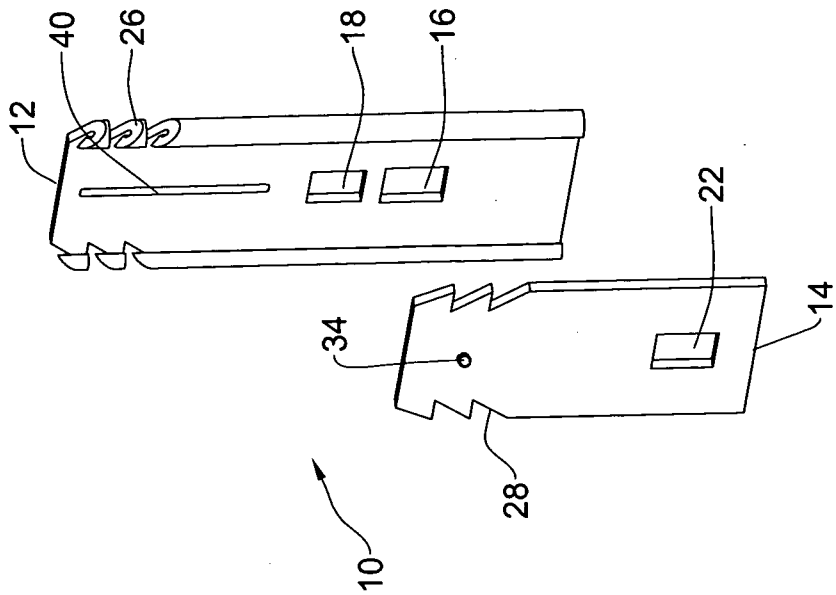


Fig. 2C

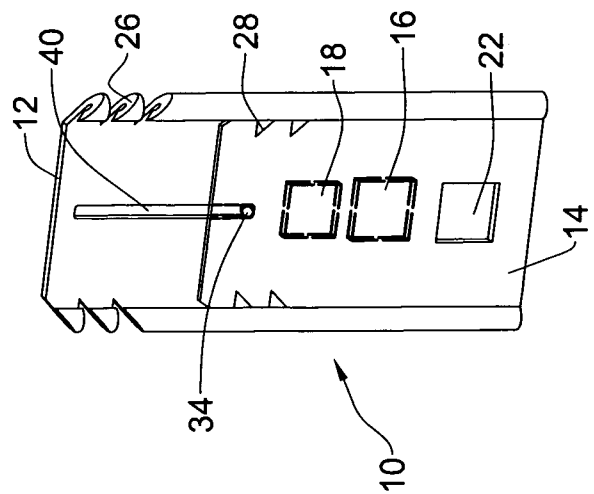


Fig. 2B

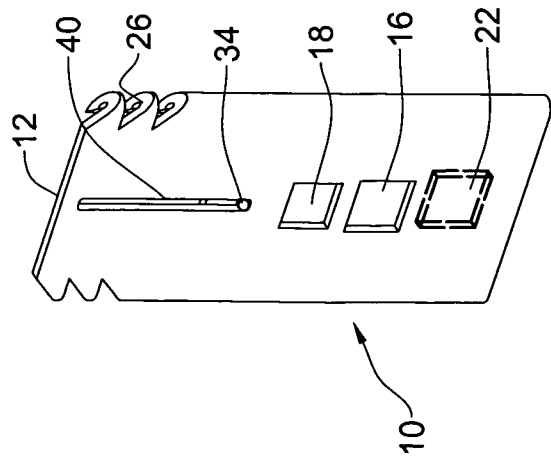


Fig. 2A

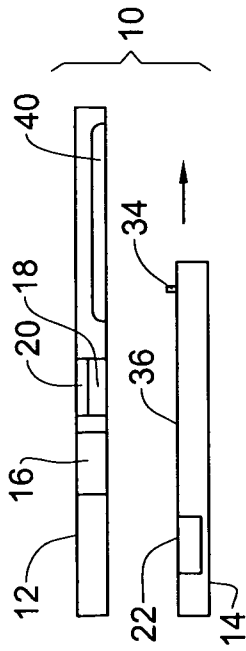


Fig. 3A

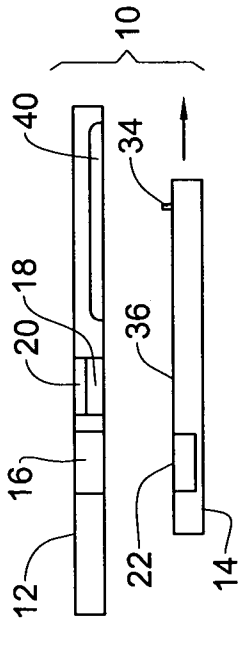


Fig. 3B

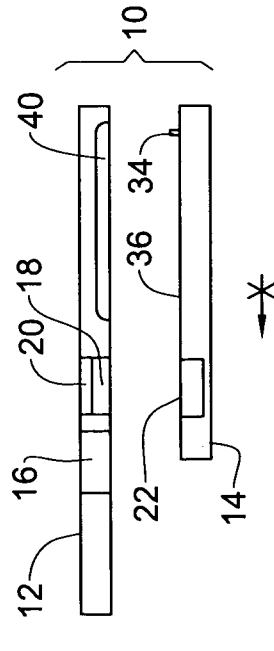


Fig. 3C

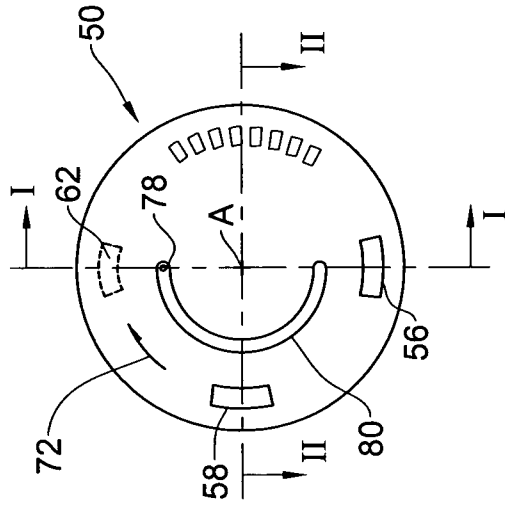


Fig. 4A

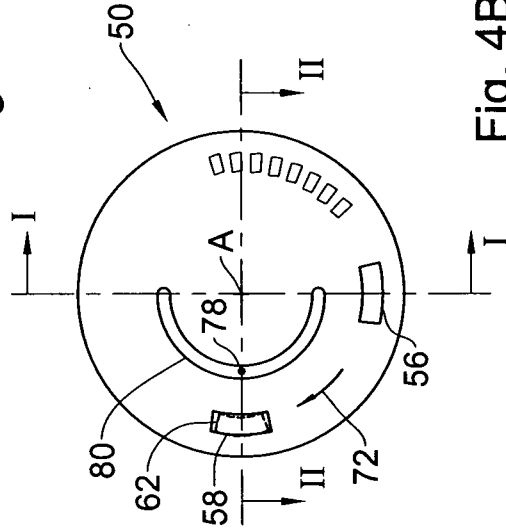


Fig. 4B

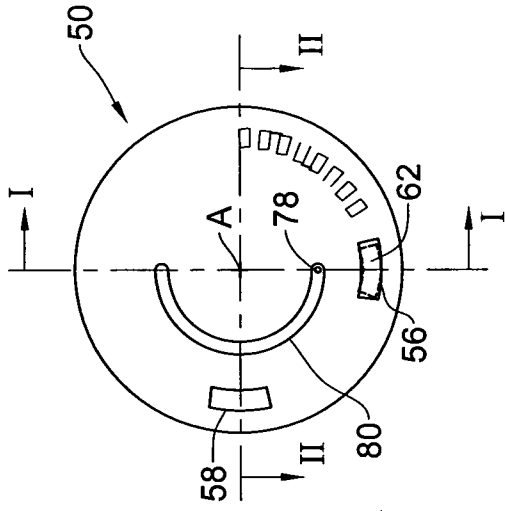


Fig. 4C

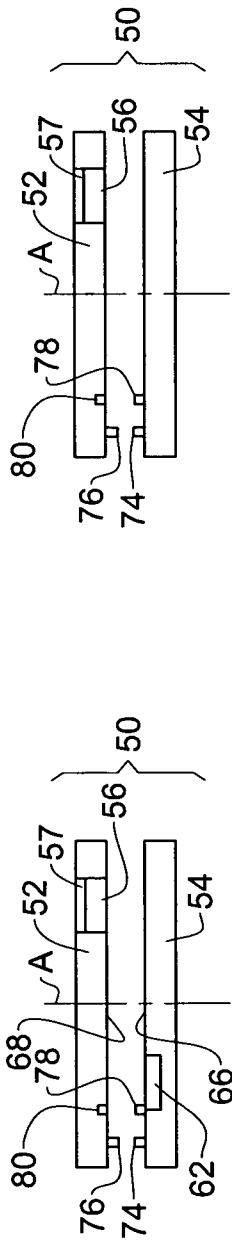


Fig. 5A

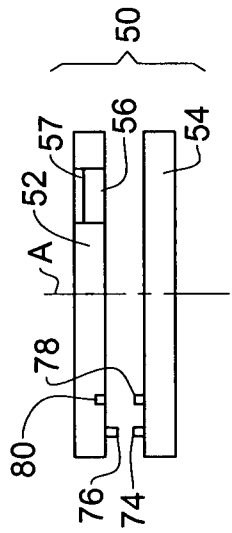


Fig. 6A

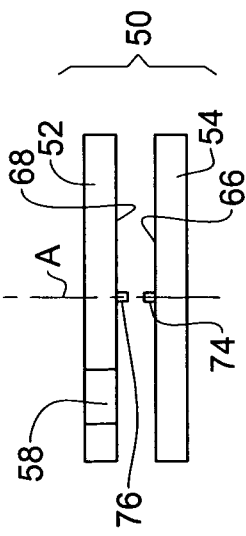


Fig. 5B

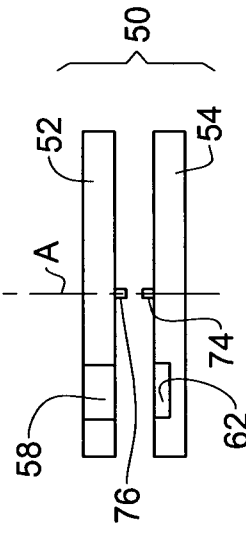


Fig. 6B

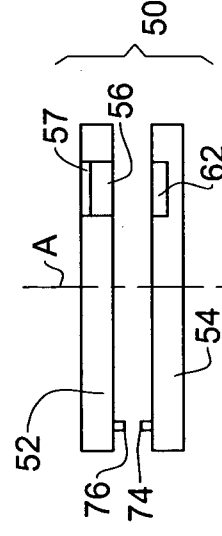


Fig. 7A

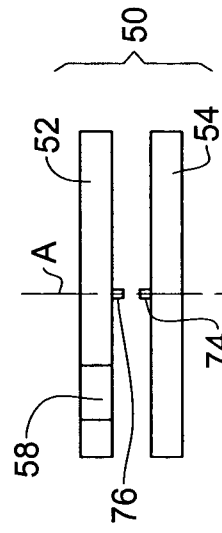


Fig. 7B

5/7

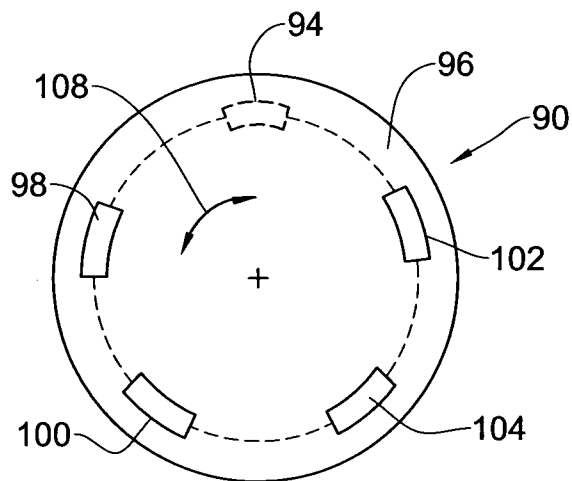


Fig. 8

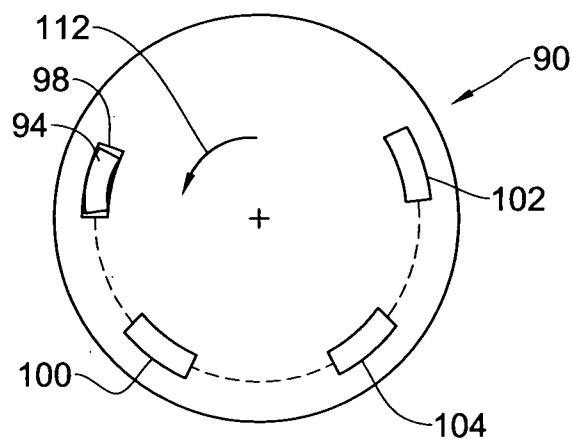


Fig. 9A

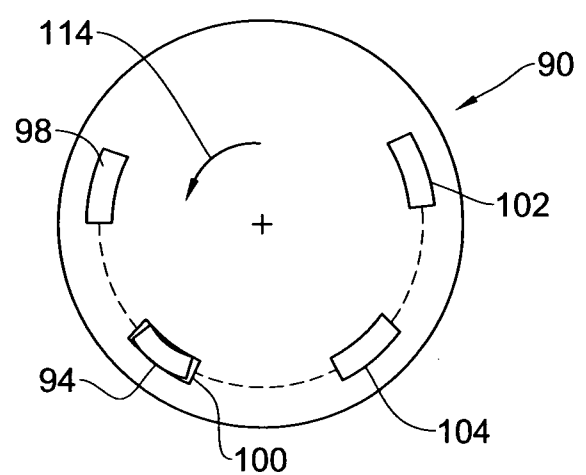


Fig. 9B

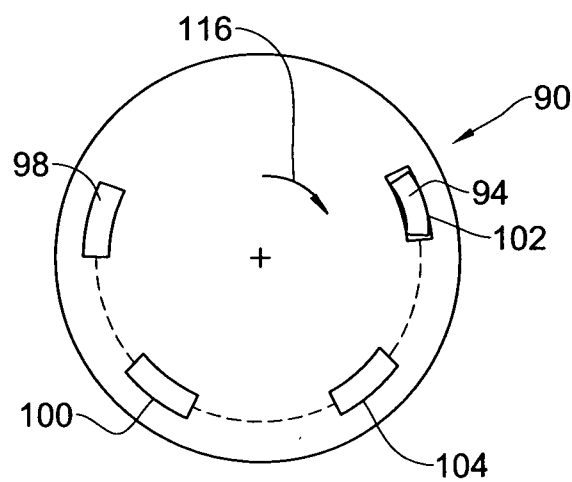


Fig. 10A

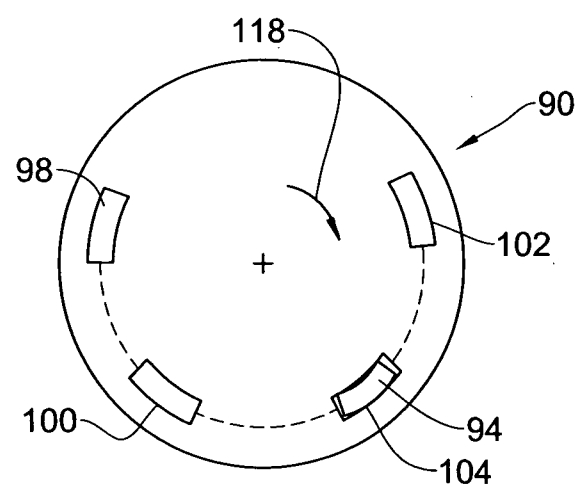


Fig. 10B

6/7

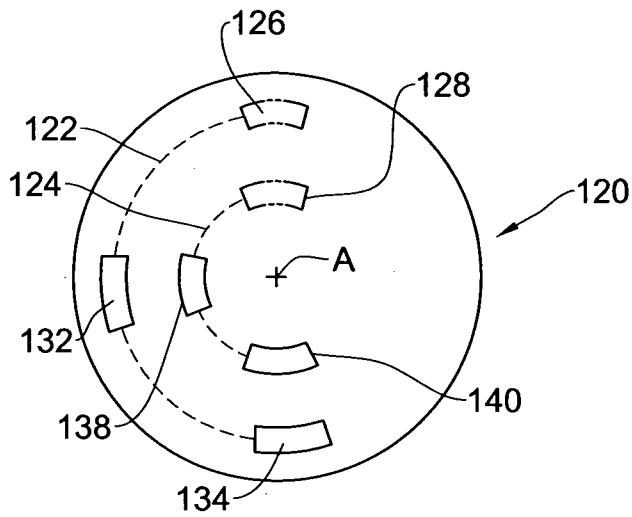


Fig. 11A

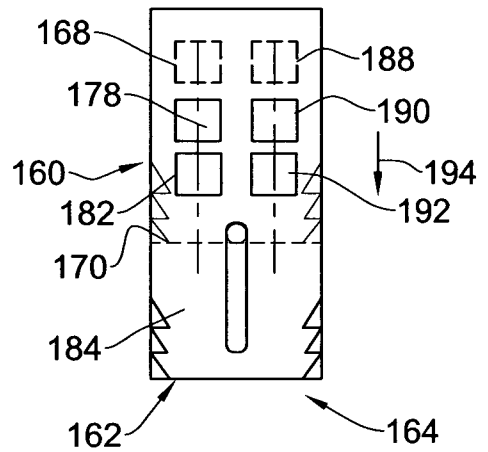


Fig. 12A

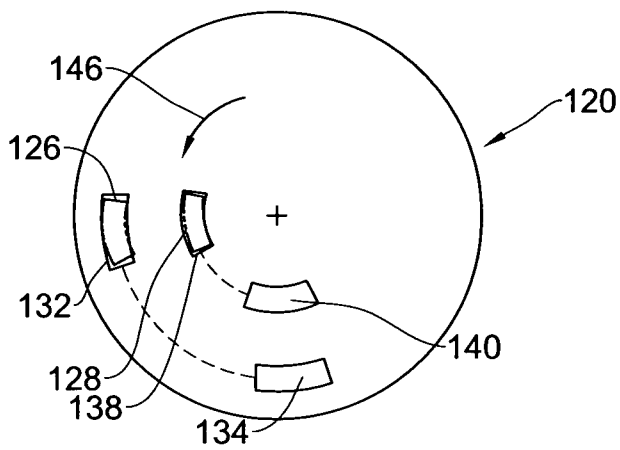


Fig. 11B

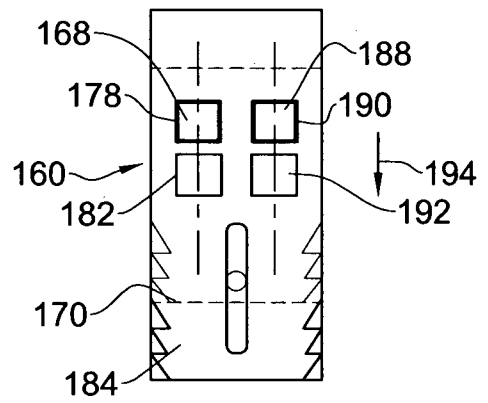


Fig. 12B

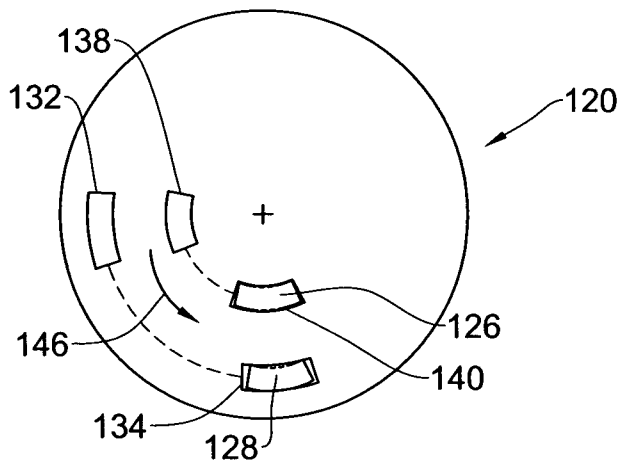


Fig. 11C

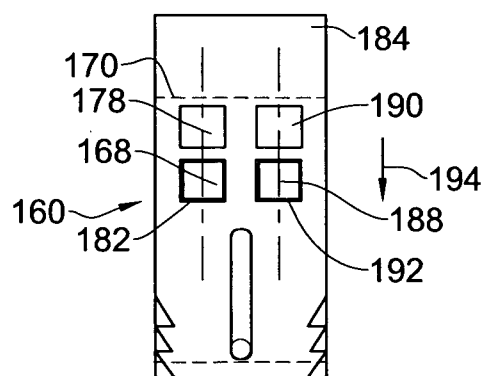


Fig. 12C

7/7

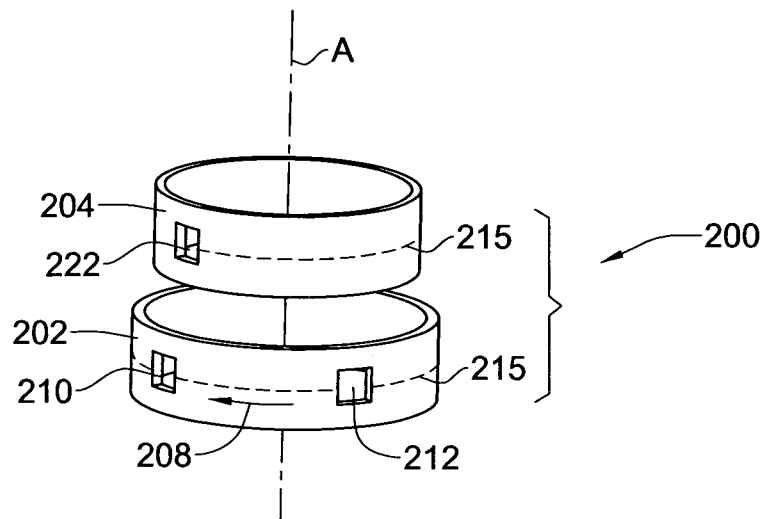


Fig. 13A

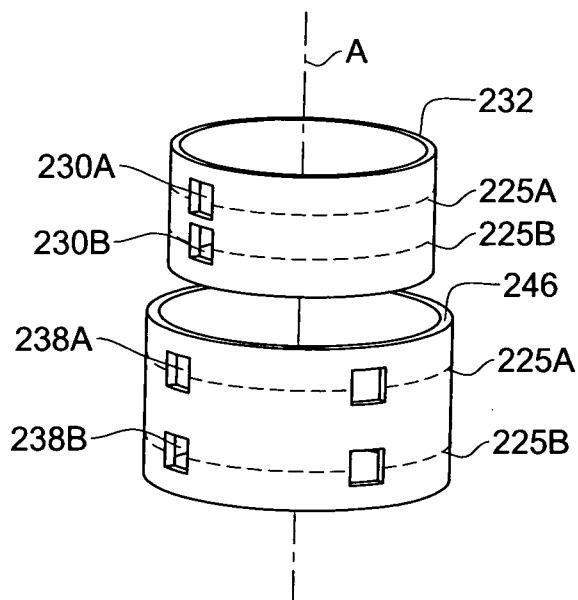


Fig. 13B

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2010/000192

A. CLASSIFICATION OF SUBJECT MATTER

INV. B01L3/00 G01N33/543 C12Q1/00
ADD.

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)

B01L G01N C12Q

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document; with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 91/19567 A1 (CHIRON CORP [US]) 26 December 1991 (1991-12-26) page 1, line 9 - line 13; figures 2-6A, page 6, lines 7-11 page 8, lines 1-5 page 10, line 33 - page 11, line 1 page 13, lines 15-26 page 16, line 30 - page 18, line 11; figures 7B,11	1-25
X	EP 0 490 447 A1 (LIVESTOCK CONTROL HOLDING [NL] FINANCIERINGSMAATSCHAPPIJ SPAR [NL]) 17 June 1992 (1992-06-17) the whole document ----- -/--	1-25

☒ 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 document 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

26 July 2010

Date of mailing of the international search report

04/08/2010

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Viskanic, Martino

INTERNATIONAL SEARCH REPORT

International application No

PCT/IL2010/000192

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 817 522 A (GOODMAN DAVID B P [US] ET AL) 6 October 1998 (1998-10-06) column 4, line 35 - column 5, line 6; figure 1 -----	1-25
X	US 5 009 846 A (GAVET LOUIS [FR] ET AL) 23 April 1991 (1991-04-23) column 3, line 63 - column 4, line 42; figures 1-4 -----	1-4, 9-25
A	US 2006/057629 A1 (KIM MIN-SOO [KR]) 16 March 2006 (2006-03-16) figures 6,7 -----	1-25
A	WO 98/00712 A1 (CHANDLER HOWARD MILNE [US]) 8 January 1998 (1998-01-08) figure 8 -----	1-25

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IL2010/000192

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9119567	A1	26-12-1991	AT 109685 T 15-08-1994
		AU 8050591 A 07-01-1992	
		CA 2084342 A1 16-12-1991	
		DE 69103420 D1 15-09-1994	
		DE 69103420 T2 01-12-1994	
		EP 0533801 A1 31-03-1993	
		ES 2057904 T3 16-10-1994	
		IE 912049 A1 18-12-1991	
		JP 5507878 T 11-11-1993	
		KR 182619 B1 01-05-1999	
		PT 98009 A 31-08-1993	
		US 5310523 A 10-05-1994	
EP 0490447	A1	17-06-1992	AT 125173 T 15-08-1995
		DE 69111394 D1 24-08-1995	
		DE 69111394 T2 07-03-1996	
		DK 0490447 T3 27-11-1995	
		ES 2077159 T3 16-11-1995	
		JP 7005169 A 10-01-1995	
		NL 9002708 A 01-07-1992	
		US 5139742 A 18-08-1992	
US 5817522	A	06-10-1998	NONE
US 5009846	A	23-04-1991	DE 68905300 D1 15-04-1993
		DE 68905300 T2 12-08-1993	
		EP 0369836 A1 23-05-1990	
		ES 2039904 T3 01-10-1993	
		FR 2637687 A1 13-04-1990	
		JP 2222839 A 05-09-1990	
		JP 2775680 B2 16-07-1998	
US 2006057629	A1	16-03-2006	KR 20060025401 A 21-03-2006
WO 9800712	A1	08-01-1998	BR 9710010 A 11-01-2000
		CA 2259307 A1 08-01-1998	
		CN 1226317 A 18-08-1999	
		DE 69736834 T2 24-05-2007	
		EP 0920621 A1 09-06-1999	
		ES 2274544 T3 16-05-2007	
		JP 3845451 B2 15-11-2006	
		JP 2001502046 T 13-02-2001	
		US 2002004245 A1 10-01-2002	
		ZA 9705741 A 27-07-1998	