Title: APPARATUS AND METHOD FOR POSITIONING AND EJECTING A TEST STRIP

Abstract: The present invention is directed to an apparatus for positioning a test strip in a meter and ejecting the test strip from the meter. In one embodiment of the present invention, an apparatus for positioning a test strip in a test strip connector and ejecting a test strip from the strip port connector. The present invention is further directed to a method for positioning a test strip in a meter and ejecting the test strip from the meter. In one embodiment of a method according to the present invention a test strip port has a first opening, a slot, a second opening, a moveable ejector assembly and a plurality of contact electrodes.
TITLE OF THE INVENTION:

APPARATUS AND METHOD FOR POSITIONING AND EJECTING A TEST STRIP

FIELD OF THE INVENTION:

The present invention is directed to an apparatus and method for positioning a test strip in a meter and ejecting the test strip from the meter, and, more particularly, to an apparatus and method for positioning and ejecting a test strip wherein a movable ejector assembly is used to eject the test strip from a test meter.

BACKGROUND OF THE INVENTION:

A variety of analyte test meters employ containers to, for example, protect the test strips stored in the test meter from damage prior to use, to maintain sterility of the test strips and to isolate the test strips from potentially adverse environmental factors such as humidity and ultra-violet (UV) light. Exemplary of such test strips are single-use test sensors (e.g., electrochemical and photometric test sensors) that are employed with an associated analyte test meter for measuring an analyte in a bodily fluid (such as glucose in whole blood).

It is common for a plurality of single-use test sensors to be stored in a container separate from an associated meter. These containers often have tight fitting lids to isolate the test strips within the container from environmental factors. However, opening the tight fitting lid of such conventional containers can require a user to apply substantial force to the lid. In addition, subsequent manual extraction of a test sensor from the opened container can be a cumbersome process. Furthermore, due to the substantial force required to open such conventional containers, users may fail to properly close the container in order to more easily facilitate the extraction of another test sensor at a later time. Unfortunately, failure to properly close the container can lead to the potentially deleterious exposure of test sensors within the container to environmental factors.
Individual test sensors can also be wrapped in foil to protect the test sensors from unfavorable environmental conditions. However, the dexterity and vision required to extract a test sensor from the foil can be lacking in some users. In addition, manual unwrapping of a foil to extract a test sensor for each and every use, and subsequent insertion of the extracted test sensor into an associated meter for analyte measurement can be a cumbersome process.

Many methods and apparatus have been designed to facilitate the storage of test strips in analyte test meters. Storage methods known in the art, include, for example a disk format or a drum format or a stacked format. However, both approaches provide less efficient storage per unit volume with respect to the size of the container compared to a stack of strips 24 as described herein. Using a disc is undesirable because the number of strips is limited by the size of the disk and shape of the strips. The diameter dimension of the disc therefore dictates the width dimension of the meter. Using a drum is also undesirable because the number of stored strips is limited by the size of the drum and the size and shape of the strips in the drum. The dimensions of the drum therefore dictate the depth dimension of the meter. When strips are stacked, it becomes difficult to arrange the stack in an orientation which minimizing the size of the meter while facilitating the presentation of the strip in an orientation which aids the user. It would, therefore, be advantageous to design a meter useful in analyzing an analyte in blood or other bodily fluids wherein the meter uses a test strip vial wherein the test strips are stacked to minimize the size of the meter. It would, further be advantageous to design a meter useful in analyzing an analyte in blood or other bodily fluids wherein the meter uses a test strip vial wherein the test strips are stacked and automatically dispensed from the test strip vial in an orientation most useful to the user while storing the stacked test strips in an orientation which minimizes the size of the meter.

SUMMARY OF THE INVENTION:

The present invention is directed to an apparatus for positioning a test strip in a meter and ejecting the test strip from the meter. In one embodiment of the present invention, an apparatus for positioning a test strip in a test strip connector and ejecting
a used test strip from the strip port connector, the apparatus comprises: a slot in the
strip port connector; a movable ejector assembly adapted to move out of the slot when
a first end of the test strip is moved into the slot, the movable ejector assembly being
further adapted to move back into the slot when a second end of the strip passes the
moveable ejector; a plurality of contact electrodes positioned in the slot, the contact
electrodes being adapted to move out of the slot when the first end of the test strip is
moved into the slot, the plurality of electrodes being further adapted to maintain
contact with the strip as the strip is moved through the slot and to contact one or more
electrical contacts on the test strip.

The present invention is directed to a method for positioning a test strip in a meter
and ejecting the test strip from the meter. In one embodiment of a method according to
the present invention a test strip port having a first opening, a slot, a second opening, a
moveable ejector assembly and a plurality of contact electrodes is used. In this
embodiment of a method of positioning, reading and ejecting a test strip in the method
comprises the steps of: sliding the test strip into a first end of the slot; pushing the
ejector assembly out of the slot as the test strip moves through the slot; pushing the
electrical contacts out of the slot as the test strip moves through the slot; moving the
ejector assembly into the slot and past the ejector assembly; positioning the electrical
contacts to contact electrical connectors on the test strip; taking a measurement;
pushing the test strip out of the slot using the ejector assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features of the invention are set forth with particularity in the appended
claims. A better understanding of the features and advantages of the present invention
will be obtained by reference to the following detailed description that sets forth
illustrative embodiments, in which the principles of the invention are utilized, and the
accompanying drawings of which:

Figure 1 shows a perspective view of a test meter with a strip in a dispensed first
position.
Figure 2 shows a perspective view of a test meter with a strip in a test position ready to accept a sample, perpendicular to the dispensed first position.

Figure 3 shows a perspective view of a stack of strips indicating example dimensions of the stack.

Figure 4 shows a perspective view of the stack of strips of Figure 3 within the potential confines of a meter, indicating example dimensions for the meter.

Figure 5 shows a perspective view of a meter with a strip dispensed in an "on edge" first position.

Figure 6 shows a perspective view of a meter with a strip dispensed in an "in line" second position, for example ready for testing.

Figure 7 shows an exploded diagram of a rotatable port connector according to a first embodiment of the invention.

Figure 8 shows a perspective view of an assembled rotatable port connector according to a first embodiment of the invention.

Figure 9 shows a cross sectional view through A-A' of Figure 8 and shows a rotatable connector port according to a first embodiment of the invention at the onset of strip insertion to the port.

Figure 10 shows the cross sectional view of Figure 9 wherein a strip has made initial contact with a pair of resiliently biased fingers.

Figure 11 shows the cross sectional view of Figure 9 wherein a strip has been located to make electrical contact with a series of resiliently biased connectors within the port.
Figure 12 shows a perspective view of an assembled rotatable port connector (as shown in cross section in Figure 11) wherein a portion of device has been cut away to reveal a strip in place within an electrical connector block.

Figure 13 shows the view of Figure 12 wherein the central portion has been rotated through 90° such that the electrical connector block has been compressed against the strip.

Figure 14 shows a cross sectional view through B-B' of Figure 13 wherein the port connector block has been rotated through 90° causing the electrical connector to be pressed against the strip.

Figure 15 shows the view of Figure 14 wherein a strip ejector mechanism has been activated to cause removal of a strip from the connector block following completion of a measurement.

Figure 16 shows the view of Figure 15 wherein a strip has been disconnected from the electrical connector and is being moved out of the connector port.

Figure 17 shows a perspective view of the closure of a cassette or vial of strips with associated dispensing mechanism and rotatable connector port according to a second embodiment of the invention.

Figure 18 shows the view of Figure 17 wherein a strip has been dispensed from the top of a stack of strips into the rotatable strip connector.

Figure 19 shows the view of Figure 17 wherein the strip connector has been rotated through 90° into a test position.

Figure 20 shows a perspective view of a rotatable strip connector according to a third embodiment of the invention showing the strip in the initial pre-load position.
Figure 21 shows the device of Figure 20 wherein rotation of the strip holder from a test position to a load position has been initiated.

Figure 22 shows the device of Figure 20 wherein the strip holder has been rotated through 90° in readiness to accept an incoming strip.

Figure 23 shows the device of Figure 20 wherein a strip has been loaded into the strip holder, which is being rotated towards the resiliently biased electrical connectors.

Figure 24 shows the device of Figure 20 wherein a strip has been moved from a load position to a test position.

Figure 25 shows the view of Figure 24 wherein the strip has been elevated to make physical contact with the resiliently biased electrical connector by rotation of an eccentric 76.

Figure 26 shows a perspective view of a rotatable strip connector according to a fourth embodiment of the invention, wherein the electrical connector is integral within the strip holder.

Figure 27 shows the device of Figure 26 from a second perspective wherein the strip connector has been rotated through 90° to accept a strip from a stack of strips.

Figure 28 shows the device of Figure 27 from a first perspective.

Figure 29 shows the device of Figure 26 wherein a strip which, has been loaded from a stack of strips into the rotatable strip connector, is being rotated back to a test position.

Figure 30 shows an end-on view of a stack of strips indicating the action of strip rotation about a central axis.
Figure 33 shows an end-on view of a stack of strips indicating the action of strip rotation about an axis offset from the centre line.

Figure 34 shows an exploded diagram of a rotatable port connector according to a fifth embodiment of the invention.

Figure 35 shows a perspective view from the rear of an assembled rotatable port connector according to a fifth embodiment of the invention.

Figure 36 shows a perspective view from the front of an assembled rotatable port connector according to a fifth embodiment of the invention.

Figure 37 shows an exploded diagram of a slide block assembly.

Figure 38 shows a cross sectional view through a rotatable port connector according to a fifth embodiment of the invention at the onset of strip insertion.

Figure 39 shows a cross sectional view through a rotatable port connector according to a fifth embodiment of the invention wherein a strip has been delivered into a test position.

Figure 40 shows a cross sectional view through a rotatable port connector according to a fifth embodiment of the invention following completion of a test measurement and just prior to discarding of the used strip.

Figure 41 shows a perspective view of a linear strip connector according to a sixth embodiment of the invention.

Figure 42 shows a cut away sectional view of the linear strip connector of Figure 41 and highlights the functional components of the linear strip connector.

Figure 43 shows a cross sectional view through linear strip connector at the onset of insertion of a test sensor.
Figure 44 shows the view of Figure 43, wherein a test sensor has made contact with an ejector.

Figure 45 shows the view of Figure 43 wherein a test sensor has been inserted sufficiently to make contact with a signal terminal in a position ready to perform a test measurement.

Figure 46 shows the view of Figure 43 following completion of a test measurement, showing movement of the ejector to displace the test sensor from the signal terminal prior to disposal of the test sensor.

Figure 47 shows a perspective view of rotatable test sensor port connector according to a fifth embodiment of the invention indicating the relationship between the slide block assembly and rear cam housing.

Figure 48 shows a perspective view of a rotatable test sensor port connector along with a drive motor according to a seventh embodiment of the invention.

Figure 49 shows a perspective view of a rotatable test sensor port connector along with a drive motor according to an eighth embodiment of the invention.

Figure 50 shows the rotatable test sensor port connector of Figure 49 with the test sensor port in a resting position.

Figure 51 shows the rotatable test sensor port connector of Figure 49 with the test sensor port in a strip load position prior to making a test measurement.

Figure 52 shows the rotatable test sensor port connector of Figure 49 with the test sensor port in a test position ready to conduct a test measurement.

Figure 53 shows the rotatable test sensor port connector of Figure 49 with the test sensor port in a discard position following completion of a test measurement.
Figure 54 shows a perspective view a rear cover of a rotatable test sensor port connector with a flexible circuit assembly.

5 DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS OF THE INVENTION

Figure 1 shows a meter 2, an outer casing 4, a user interface 6, a strip delivery port 8, a strip 10, buttons 12, 14, 16, a visual display 18, a sample application area 20 and sample fill indicator window 22.

Figure 1 shows a perspective view of a meter 2. Outer casing 4, which is substantially rectangular, has a first major surface upon which the user interface 6 is provided and a second major surface opposite the first major surface. A first elongate side contains a strip delivery port 8. A strip 10 is delivered through strip delivery port 8. Strip 10 is rectangular in this embodiment and has a first major surface upon which sample application area 20, sample fill indicator window 22 and a series of contact electrodes (not shown) are provided and a second major surface opposite the first major surface substantially perpendicular to the first major surface containing user interface 6. User interface 6 comprises a series of buttons 12, 14, 16 that may be used to control operation of meter 2 and a visual liquid crystal or other display 18 to present information to a user of the meter 2.

A strip 10, which is substantially rectangular and elongate, has a first major surface upon which is provided a sample fill indicator window 22 and a series of contact electrodes (not shown) that are used to form an electrical connection between the strip and meter and a second major surface. Strip 10 further comprises a sample application area 20 located on a distal end and a series of contact electrodes (not shown) disposed at the proximal end, which make electrical contact with a strip delivery port 8 in the meter 2. Fill indicator window 22 is provided to give a user a visual indication that sufficient sample has been correctly applied to strip 10 to enable a successful measurement to be made.
In one embodiment meter 2 may contain one or more strips within a storage region or container (not shown). Delivery of a strip 10 from such a storage region or container may occur automatically, by depressing button 12, for example. A user may then apply a sample of fluid, for example a body fluid such as blood, interstitial fluid (ISF), urine to the strip 10 in order to make a measurement of an analyte or indicator within the sample, e.g. glucose, urea, HbA1c, haematocrit.

Figure 2 shows the meter 2 of Figure 1 within which strip delivery port 8 and hence strip 10 have been rotated through 90° relative to outer casing 4 of meter 2 such that first major face of strip 10 is aligned to be substantially parallel with the major face of casing 4 containing user interface 6. Sample fill indicator window 22 and sample application area 20 are thus visible to user from the same direction as visual display 18. A user of meter 2 may thus view fill indicator window 22, concurrently with visual display 18, while applying a sample of blood and/or ISF from a finger, for example. Thus, during the process of sample application a user of meter 2 may be enabled to follow any directions or instructions given on visual display 18 while applying a sample of blood and/or ISF from a fingertip to strip 10.

When using self monitoring blood glucose meters it is convenient for many users to be sitting at a table, for example. It is particularly desirable for a user to be able to apply a sample of blood to a strip 10 with the meter 2 on a tabletop or similar flat surface. Also, even when not at a table it is important that the fill indicator window on the strip be visible at the same time as the result on the display. It is therefore of importance that a strip 10 be presented in a “flat” position with the first major surface of strip 10 substantially parallel with the first major surface of meter 2. A user may thus be able to view fill indicator window 22 at the same time as visual display 6. During the process of sample application a user may thus be able to follow any “on screen” instructions while applying blood from a finger. Therefore the provision of means within meter 2 that can transfer a strip 10 in an “on edge” orientation from a stack of strips 24 contained within meter 2 and present the strip 10 in a “flat” position to a user of meter 2 will be of significant benefit. This allows a compact construction using a compact stack of strips while allowing an easy viewing presentation of the strip relative to the stack of strips, again using a compact rotation mechanism. Indeed, many,
if not all traditional meters wherein a user has to manually place a strip into a strip connector port within the meter, present the strip with the uppermost surface substantially parallel with the major surface of the meter upon which the user interface is present.

Figure 3 shows a plurality of strips 10 as a stack of strips 24, a sample application area 20, sample fill indicator window 22 and a series of contact electrodes 26. The figure shows a perspective view of a stack of strips 24. The first major surface of strip 10 is visible and shows the fill indicator window 22 and contact electrodes 26 which are used to make electrical connection between the strip 10 and meter 2. A strip 10 may have one or more sensor electrodes (not shown) in the proximity of the sample application port 20, typically beneath fill indicator window 22. A number of conductive tracks (not shown) are provided within strip 10 that provides a conductive link between contact electrodes 26 and the sensor electrodes that are beneath fill indicator window 22.

The dimensions of an individual strip 10 (for example about 15mm x about 5.5mm x about 0.63mm) define the dimensions of a stack of strips 24. Thus for example, a stack of 50 individual strips may occupy a volume as small as about 31.5mm long by about 15mm wide and about 5.5mm thick. The provision of such a stack of strips within a storage cassette or vial that may be inserted within a meter 2 (as shown in Figure 1) will thus impact on the overall dimensions of meter 2. The casing 4 of meter 2, when compared with a prior art meter e.g. OneTouch® Ultra, will have enlarged external and internal dimensions in order to accommodate the stack of strips or the cassette or vial used to contain the stack of strips 24.

Firstly it is desirable that the overall dimensions of a meter be as small as possible to aid the user of such a device in cases where handheld operation is required. When providing a number of strips within a meter, the meter must necessarily be of greater size than if such a number of strips were not provided. Although such devices are typically handheld and require the user to hold a strip 10, present in delivery port 8, up to the sample to be analysed, the present invention may also be used on a tabletop or
similar flat surface. In which case a user may hold a finger up to the strip 10 to apply a sample of blood, rather than holding the meter 2 with strip 10 up to the lanced finger.

Secondly, one of the most compact strip orientations to use in a meter to keep the meter size small is a stack. A stack is typically elongate and rectangular and this can dictate the shape of the meter. Nevertheless on dispensing of a strip 10 from a stack of strips 24, the uppermost strip 10 exits the rectangular meter 2 on one of the minor elongate sides of the meter 2. Typically the display 18 is on one of the major sides of the meter 2 and it can therefore be difficult for a user to orientate the meter 2 appropriately to apply a sample of blood from a finger. Also, it can be difficult for a user to see a strip 10 to assess when it is full at the same time as viewing the display.

It has been suggested that the thickness of a meter 2 should be less than 25mm, e.g. typical thickness of a mobile phone, in order that it may fit comfortably within a pocket, may be readily handled during use and is as discrete to use as possible. Where a stack of strips 24 are to be provided for use within a meter 2, if the stack 24 were to be oriented “on edge”, i.e. with each strip 10 aligned such that the first major surface of one strip 10 is in direct contact with the second major surface of the next strip 10 in the stack 24, and the first edge of the strip 10 substantially parallel to the first major surface of outer casing 4 the over all dimensions of the stack 24 may be kept to a minimum, while maximising the number of strips 10 that might be provided in the stack 24 as indicated within Figure 4.

Figure 4 shows a meter 2, an outer casing 4, a strip 10 and a stack of strips 24. Figure 4 indicates in outline one embodiment of a stack of strips 24 within an outer casing 4 of a meter 2. The schematic figure indicates the desirable thickness of meter 2, which is typically ≤ 25mm. The functional electronics of the meter 2 may therefore be sufficiently compact to fit around stack 24, within an outer casing 4 that may fit comfortably in the palm of the hand. Thereby facilitating a user of such a device to make a measurement of blood glucose with an associated strip or test sensor 10, with minimum inconvenience.
As described in relation to Figure 1, if a stack of strips 24 is provided within outer casing 4, dispensing a strip 10 through delivery port 8 from stack 24 would present the strip with its first major surface perpendicular to first major surface of outer casing 4.

Figure 5 shows a meter 2, with outer casing 4, strip delivery port 8, strip 10, sample application area 20, fill indicator window 22, stack of strips 24. Arrow 28 indicates the direction in which a strip 10 would be delivered if it were to be pushed directly from the top of a stack of strips 24 in an “on edge” orientation to a test position. However, as discussed with relation to Figure 2 it is desirable to present the first major surface of strip 10 substantially parallel with the major surface of outer casing 4 of meter 2. Therefore an approach that delivers a strip or test sensor 10 in a direct linear path from a stack of strips 24, which is contained within the casing 4 of meter 2, would not achieve the aim of providing a strip 10 in an orientation that is beneficial for a user to apply a sample.

Figure 6 shows a meter 2, outer casing 4, delivery port 8, strip 10 and fill indicator window 22. Strip 10 is shown in the preferred orientation with the first major surface of strip 10 substantially parallel with the first major surface of outer casing 4. In order to present strip 10 substantially parallel to the first major surface of casing 4, a rotation means is required. The rotation means takes strip 10 from a stack of strips 24 in a substantially perpendicular orientation and then rotates the strip through 90° to an orientation in which the first major surface of the strip is substantially parallel with respect to first major surface of casing 4.

Typically, the rotation means fits within the confines of the substantially rectangular outer casing 4. The outer casing 4 therefore defines a cavity that is sufficient to contain and support a rotation mechanism that may be aligned with a stack of strips 24, such that it may accept a strip 10 directly from the top of the stack of strips 24 and subsequently move the strip 10 through 90° relative to the stack of strips 24. Thus a strip 10 may be presented to a user of a meter 2 in an orientation that enables the visual display 18 and fill indicator window 22 to be viewed concurrently.
As will be described in Figure 30 to Figure 33, two relatively compact ways of rotating a strip relative to a stack of strips will be described. Particular example of means for rotating strips will now be described.

Figure 7 shows rotatable port connector 33, strip delivery port 8, strip 10, contact electrodes 26, rotatable barrel 30, gear teeth 32, interlocking features 31A, 31B, 41A, 41B, cavity 34, resiliently biased grippers 36, resiliently biased electrical connector 38, connector block 40, body 42, smoothly shaped feature 50, groove 52, strip ejector arm 44, pivot rod 46, pivot bore 48. Arrows 28, 29 indicate direction of movement of strip 10.

Figure 7 shows a perspective view of an exploded rotatable port connector 33 according to a first embodiment of the invention. The rotatable port connector comprises a rotatable barrel 30. Rotatable barrel 30 has a first major surface that is provided substantially coplanar with the first elongate side of outer casing 4 of meter 2. Strip delivery port 8 is present on the first major surface of rotatable barrel 30. A series of gear teeth 32 are positioned around the circumference of rotatable barrel 30 in the proximity of the first major surface such that gear teeth 32 would be hidden within outer casing 4 when rotatable barrel 30 is located in the first elongate side of outer casing 4. Gear teeth 32 around barrel 30 interact with additional gear wheels (not shown) that provide mechanical rotational force to drive barrel 30 from a strip loading position to a testing position. There is a cavity 34 within barrel 30 to accept a connector block 40. A pair of resiliently biased grippers 36 is mounted in the one end of barrel 30 in line with strip delivery port 8. A series of resiliently biased electrical connectors 38 locate within connector block 40. Connector block 40 is slidably mounted within cavity 34 of barrel 30. Body 42 supports rotatable barrel 30 within or adjacent the first elongate side of outer casing 4.

Strip ejector arm 44 has a pivot rod 46 that locates within pivot bore 48 on an outermost side of body 42. Rotatable barrel 30 and body 42 have a pair of interlocking features 31A and 41A and 31B and 41B respectively, which limit the degree of rotation of barrel 30 within body 42.
In use, connector block 40 sits within cavity 34 of rotatable barrel 30. Connector block 40 has a smoothly shaped feature 50 that controls the motion of rotatable barrel 30 within body 42. Shaped feature 50 of connector block 40 that interacts with a cooperating protruding variably shaped feature 68 (shown in Figure 12) that is located within an internal wall of body 42, approximately opposite the strip ejector arm 44. Resilient biased electrical connectors 38 are S-shaped. The free ends of connectors 38 terminate above strip load channel 58 (see Figure 9) when the port connector is assembled, such that when a strip 10 is dispensed from the rear of body 42 through to delivery port 8 there is no initial contact between electrical connectors 38 and strip 10. Port 8 is elongate as is groove 52 to allow a strip to pass therethrough. In a first condition, port 8 is parallel to groove 52 in body 42. When strip delivery port 8 is inline with groove 52 in the rear wall of port body 42, strip 10 can move freely within the barrel in direction 28 and also in reverse in direction 29. However, when barrel 30 is rotated through 90° relative to body 42, such that the elongate axis of port 8 is approximately perpendicular to the elongate axis of groove 52, the rear wall of port body 42 prevents movement of strip 10 in direction 29. Resiliently biased grippers 36 apply a force inwardly to the edges of strip 10 to prevent accidental release/loss of strip 10 through delivery port 8 prior to making a measurement.

The port 56 (not shown) of the invention accepts a test sensor from an integral cassette or vial and subsequently rotates the test sensor through 90° relative to an axis within the meter to improve the ergonomics of sample application.

Figure 8 shows a perspective view of the assembled rotatable port connector 33. The port 56 (not shown) of the invention accepts a test sensor from an integral cassette or vial and subsequently rotates the test sensor through 90° relative to an axis within the meter to improve the ergonomics of sample application.

Figure 8 shows strip delivery port 8, strip 10, contact electrodes 26, rotatable barrel 30, gear teeth 32, rotatable port connector 33, connector 40, body 42, ejector arm 44, pivot rod 46, pivot bore 48, shaped feature 50. Arrow 28 indicates the direction of strip insertion. Dotted line A-A' indicates location of cross section (see Figure 9).

Connector block 40, with associated electrical connectors 38 (not visible) is located within cavity 34 of rotatable barrel 30. Resiliently biased grippers 36 (not visible) are also located within barrel 30, in line with strip delivery port 8 and strip load channel 58 (not visible). Strip ejector arm 44, located within pivot bore 48, is in line with strip
delivery port 8 when barrel 30 is in a load position, i.e. ready to accept an incoming strip 10 from a direction 28. However, ejector arm 44 is prevented from entering load channel 58 when barrel 30 is in a load position. In a load position the outer wall of barrel 30 substantially blocks access to elongate groove 52 by ejector arm 44. Ejector arm 44 is therefore prevented from interfering with a strip 10 during loading of a strip into barrel 30.

A strip 10 may be delivered from a stack of strips 24 that is located against the rear face of body 42. A strip 10 may be pushed from a stack of strips 24 in the direction of arrow 28 by a strip pusher (not shown). An incoming strip will initially interact with resiliently biased grippers 36, as shown in Figure 9.

Figure 9 shows a cross sectional view through A-A’ of Figure 8. Figure 9 shows delivery port 8, strip 10, fill indicator window 22, contact electrodes 26, rotatable barrel 30, ejector arm 44, pivot bore 48, elongate groove 52, ejector groove 54, entry port 56, strip load channel 58.

An entry port 56, which has an inwardly reducing profile, provides a means to direct a strip 10 from a stack 24 into strip load channel 58. The tapered mouth of entry port 56 is provided to accommodate slight variation in the axis of delivery of strip 10 from stack 24. Therefore, entry port 56 may prevent jamming of a potentially misaligned strip in load channel 58. Load channel 58 defines an elongate aperture within barrel 30. Load channel 58 terminates in strip delivery port 8 on the surface of barrel 30 that lies on outer casing 4. Load channel 58 has internal dimensions substantially similar to strip 10, such that strip 10 may pass through channel 58, but is sufficiently constrained within channel 58 that it is prevented from moving significantly in a lateral direction within the channel.

Figure 9 shows the situation immediately prior to strip 10 making contact with resiliently biased grippers 36. In an initial strip loading position, the elongate axis of strip delivery port 8 is aligned with that of groove 52 and strip entry port 56 within the distal surface of body 42. When a strip 10 is pushed from a stack of strips 24 into rotatable port body 42, the strip initially passes through entry port 56 and enters a strip
load channel 58 that runs through barrel 30 and terminates in strip delivery port 8 on
the proximal surface of barrel 30. A strip pusher (not shown) applies sufficient force in
direction of arrow 28 to the distal end of strip 10 to cause grippers 36 to deform
outwardly, thus permitting strip 10 to enter therebetween.

An elongate ejector groove 54 along the cylindrical wall of barrel 30 is provided to
allow a used strip 10 to be ejected from barrel 30 once a measurement has been made.
When barrel 30 has been rotated within body 42 through an angle 90° into a test
position, ejector groove 54 becomes aligned with elongate groove 52 that is positioned
within body 42. When groove 52 and groove 54 are aligned, strip ejector arm 44 can
pivot freely about pivot bore 48, such that ejector arm 44 may enter barrel 30.

While barrel 30 is in a load position, i.e. it is aligned with strip entry port 56, the
cylindrical wall of barrel 30 substantially blocks groove 52 and thus prevents strip
ejector arm 44 from moving into the barrel to interact with the strip 10. Thus
preventing possible jamming of strip 10 against ejector arm 44, or premature release of
strip 10 from port connector 33.

Figure 10 shows a plan view of Figure 9 where a strip 10 is in initial contact with
grippers 36. The pressure applied to strip 10 by grippers 36 is sufficient to hold the
strip 10 within barrel 30. Thus should rotatable port connector 33, or more specifically
meter 2, be accidentally turned so that strip 10 was to point downwardly enabling
gravity to cause the strip to fall, the pressure applied by grippers 36 should retain strip
10 within barrel 30.

While strip 10 is held in this initial load position, or indeed during the loading of
the strip into barrel 30, any rotation of barrel 30 within port body 42 could result in
damage of the strip 10. This is because entry port 56 within body 42 and load channel
58 within barrel 30 may effectively act as a guillotine. As barrel 30 rotates within body
42, entry port 56 and load channel 58 are moved from a substantially coplanar axis to
an opposing axis. A pair of interlock grooves 62, 64 (see Figure 11) are provided on a
lowermost surface of strip entry port 56 and strip load channel 58 respectively. When
barrel 30 is correctly aligned within port body 42, interlock grooves 62, 64 co-align.
There is an upstanding feature on the strip pusher (not shown) that engages both interlock grooves 62, 64 and acts to prevent accidental rotation of barrel 30 within port body 42 during strip loading.

Strip entry port 56 within rotatable port body 42 has a tapered lead-in that ensures when a strip 10 is pushed from stack 24 there is an increased likelihood that the strip will be successfully delivered into strip load channel 58 and consequently strip delivery port 8. When barrel 30 is in a load position, load channel 58 is aligned substantially coplanar with entry port 56. However, when barrel 30 is rotated through 90° within port body 42 to a test position the delivery path from entry port 56 to barrel 30 is blocked. Therefore during the course of making a measurement a user would be prevented from accidentally releasing another strip 10 from stack 24, which would otherwise dislodge the strip 10 currently being used to analyse a sample.

When strip 10 has been pushed sufficiently far into barrel 30, contact electrodes 26 will align beneath resiliently biased electrical connectors 38. Region 60, shown in Figure 11, indicates the point of contact between strip 10 and resiliently biased electrical connectors 38. One end of strip 10 rests between grippers 36 while the free end lies outside outer casing 4 (not shown) so that a user can apply a sample to the sample receiving area 20. Interlock grooves 62, 64 are visible in this figure now that strip 10 has been correctly aligned beneath electrical connectors 38 and strip pusher (not shown) has been withdrawn. Strip 10 is fully contained within barrel 30 having passed completely through body 42 on its way to this position, such that barrel 30 may freely rotate within port body 42 without causing damage to the strip 10.

Figure 12 shows the perspective view of Figure 8 of an assembled rotatable port connector 33, wherein a section of barrel 30 has been removed to reveal connector block 40 in more detail. Contact electrodes 26 on strip 10 lie beneath electrical connectors 38. Electrical connectors 38 are supported by connector block 40. While in an initial strip loading position connectors 38 do not apply any significant force to strip 10. However, as barrel 30 is caused to rotate through 90°, under the action of a gear wheel (not shown) interacting with gear teeth 32 in the direction of arrow 66, connector block 40 is urged towards strip 10.
A protruding feature 68 is provided directly opposite groove 52 within body 42. Protruding feature 68 is positioned so as to cause compression of connector block 40 against strip 10.

Figure 13 shows a strip 10, sample application port 20, fill indicator window 22, rotatable barrel 30, body 42, ejector arm 44, pivot rod 46, pivot bore 48, elongate groove 52, variably shaped protruding feature 68. Line B-B' indicates cross section (see Figure 14). Rotatable barrel 30 is caused to rotate by the action of a drive cog (not shown) that interacts with gear teeth 32 around barrel 30. When rotatable barrel 30 is rotated in direction of arrow 66 by the action of the drive cog (not shown), connector block 40 and more specifically smoothly shaped feature 50 of block 40 comes in contact with protruding feature 68 on the sidewall of body 42. The consequence of the interaction between smoothly shaped feature 50 on connector block 40 and protruding feature 68 is to cause resiliently biased electrical connectors 38 to be compressed against electrode contacts 26 on strip 10. Thereby a measuring circuit is formed between the electronics of the meter 2 and strip 10. Furthermore, the additional pressure applied to the strip 10 ensures that it remains within rotatable connector port during the course of a sample measurement.

When barrel 30 is rotated through 90° such that strip 10 is moved from a load position to a test position, slot 52 within body 42 becomes aligned with groove 54 in barrel 30. Strip ejector arm 44 is therefore free to move into and out of elongate groove 52 and ejector groove 54. Thus, following analysis of a sample e.g. blood, to determine the concentration of an analyte, e.g. glucose, ejector arm 44 may be actuated to cause strip 10 to be pushed from connector port 33 in preparation for a next analysis cycle.

Figure 14 shows a cross sectional view taken through line B-B' of Figure 13. Figure 14 shows strip delivery port 8, strip 10, sample application port 20, electrode contacts 26, rotatable barrel 30, resilient electrical connectors 38, connector block 40, body 42, ejector arm 44, smoothly shaped feature 50, elongate groove 52, ejector groove 54, delivery port 56, interlocking grooves 62, 64, variably shaped protruding feature 68. Connector block 40 has been urged towards strip 10 due to interaction of
surface 50 with protrusion 68, during rotation of barrel 30 through 90° within port body 42. Resiliently biased electrical connector(s) 38 are pressed against electrode contacts 26 on strip 10.

Once a strip 10 has been correctly located within barrel 30, rotation of barrel 30 through 90° within body 42 effects rotation of strip 10 about its longitudinal axis. Thus strip 10 is moved from an “on edge” orientation to a “flat” orientation such that the first major surface of strip 10 is aligned substantially parallel with the first major surface of casing 4. During the rotation of barrel 30 within port body 42, strip load channel 58 is moved from a position where it is parallel with entry port 56, to one where it is perpendicular to entry port 56. Insodoing, access to load channel 58 is blocked by rearmost solid surface of body 42. Therefore once a strip 10 is correctly positioned within load channel 58 beneath connector block 40, the strip 10 would be prevented from moving rearwards within the channel 58 in the event that a force was applied to the end of strip 10 in direction of arrow 29. This, combined with the pinching force applied to strip 10 by resiliently biased grippers 36 and compressive force applied by resiliently biased electrical connectors 38, act to ensure strip 10 is maintained in the correct position for the purpose of performing an analysis on a liquid sample.

Figure 15 shows the cross sectional view of Figure 14 following completion of a measurement of sample. Strip ejector arm 44 has been activated. Ejector arm is rotated about pivot 46 held within pivot bore 48. The distal end 70 of ejector arm 44 travels between ejector groove 52 and ejector slot 54. Initial contact between the distal end 70 of ejector arm 44 occurs at one end of strip 10. Ejector arm 44 applies sufficient force so as to dislodge strip 10 from the gripping force applied to the strip 10 by resiliently biased electrical connector 38 and resiliently biased grippers 36. The initial force required to dislodge strip 10 is sufficiently great that accidental release should not occur. However, once sufficient force has been applied through ejector arm 44 to push sensor 10 beyond the grip of electrical connector 38 and grippers 36, strip 10 freely travels through load channel 58 and out through strip delivery port 8, from where it may be disposed.
Figure 16 shows the cross sectional view of Figure 15 wherein strip 10 has been displaced from beneath connector block 40 by ejector arm 44. Once ejector arm 44 has been fully rotated about pivot 46 to the extent that it can rotate no further, the user of the meter may readily remove the used strip from the meter for disposal. Once the used strip 10 has been successfully removed from strip delivery port 8, barrel 30 may be returned to the load position. Strip load channel 58 will be realigned with strip entry port 56 in readiness to accept a next strip prior to the user making another measurement.

The rotation of strip 10 about its central axis in barrel 30 within body 42 provides a space efficient means of taking a strip from an edge position to a flat position to facilitate sample application.

Figure 17 shows a strip rotation mechanism 71, strip 10, rotation body 72, load channel 58, pivot 73, eccentric 76, strip storage portion 77, strip vial 82, vial cap 84, strip pusher 80, strip load actuator 78, slide 74, lift pin 57, lifter 59. Figure 17 shows a perspective view of a strip rotation mechanism according to a second embodiment of the invention. The device shows a rotation mechanism 71 that is coupled to a strip storage and dispensing portion 77. Strip rotation mechanism 71 comprises strip rotation body 72, strip load channel 58, lift pin 57, lifter 59, slide 74 with pivot 73, eccentric 76. Rotation mechanism 71 is fixedly attached to strip storage portion 77 through eccentric 76 and slide 74. When strip load actuator 78 is moved there is a concomitant movement of lifter 59 and hence slide 74. Strip storage portion 77 comprises amongst other things, strip vial 82, with associated vial cap 84 that houses a stack of strips 24, strip pusher 80 and strip load actuator 78.

When load actuator 78 is pushed in a direction substantially parallel to a strip 10 (right to left as drawn) on stack of strips 24, a process to transfer a strip from vial 82 to strip rotation mechanism 71 occurs. As load actuator 78 is moved as described, lifter 59 causes vial cap 84 to be raised away from vial 82, thereby revealing the next strip 10 on the stack of strips 24. Movement of lifter 59 in a substantially perpendicular direction with respect to stack of strips 24 causes lift pin 57 to move upwardly. The effect of which is to cause pivot 73 and eccentric 76 to move within slide 74, ensuring load
channel 58 is placed substantially parallel and co-linear with a strip 10. Continued movement of load actuator 78 towards rotation mechanism 71 causes strip pusher 80 to move between the uppermost surface of vial 82 and lowermost surface of vial cap 84. Insodoing a strip 10 is pushed from the top of stack 24 into load channel 58.

As shown in Figure 18, when load actuator 78 is fully displaced along its axis of movement in the direction of strip rotation mechanism 71, strip pusher 80 is completely extended, and protrudes beyond vial 82, such that strip 10 is delivered fully into load channel 58. Once strip 10 is held within load channel 58, load actuator 78 is retracted (Figure 19). Once load actuator 78 has returned to its resting state, vial cap 84 is lowered and resealed onto vial 82. Strip pusher 80 is also returned to a resting position. Vial cap 84 forms an airtight seal with vial 82, such that the environment within the vial is controlled. The longevity of the test sensor within the vial is dependant upon temperature, and more importantly on the humidity within the vial being controlled within defined limits.

A further consequence of load actuator 78 being returned to a resting position is to cause vial cap 84 to return to a closed position, thus sealing vial 82 and therefore preventing exposure of the strips 10 stored within the vial from being unduly exposed to the environment. As load actuator 78 is returned to a pre-load resting position, vial cap 84 is moved downwardly towards vial 82, closing the vial and thereby preventing damage to the stored strips within the vial. Eccentric 76 is fixedly attached to lifter 59 (not shown), and therefore as lifter 59 is moved downwardly, slide 74 is also caused to move downwardly. Slide 74 causes a concomitant rotation of rotational body 72 about pivot 73. Thus, strip rotation mechanism 71 is moved from a position substantially coplanar with stack of strips 24 to a test position substantially perpendicular to stack of strips 24. Therefore a strip 10 is effectively moved from a load position in line with stack of strips 24 to a test position, ready to accept a sample of blood and or ISF from a user of the device. Strip 10 is thus rotated about an axis offset from the centreline of the strip 10. During the process of rotating strip 10, contact electrodes 26 are brought into contact with a series of resiliently biased electrical connectors 38 (not shown).
Figure 20 shows a strip 10, fill indicator window 22, contact electrode, 26, frame 81, frame stop 83, strip holder 75, holder stop 85, eccentric 76, rotation axle 79, load channel 58, electrical connector 38, delivery port 56, rotation surface 92, pusher surface 86, push point 88, flat surface 90. The perspective view of Figure 20 shows a strip rotation mechanism 71 according to a third embodiment of the invention. Rotation mechanism 71 comprises a strip load channel 58, slide 74, and eccentric 76. Resiliently biased electrical connector 38 is fixed at a position substantially perpendicular to stack of strips 24 (not shown). Thus a strip 10 when pushed from a stack of strips must be rotated through 90° to make contact with electrical connector 38. Insodoing, strip 10 is presented to a user in an orientation that is convenient for sample application.

During loading of a strip 10 from a stack of strips 24, load channel 58 is rotated through 90° from a test position, where it is aligned beneath electrical connector 38, to a load position, where it is substantially coplanar with an incoming strip that is pushed from a stack of strips 24 (not shown). The movement of eccentric 76, which rotates about axle 79, against the flat surface 90 of strip holder 75, causes strip holder 75 to rotate in direction 100. The profile of the outer edge 92 of eccentric 76 is such that as it rotates about axle 79 of frame 81 it has a number of effects on strip holder 75. As a result of the offset centre of eccentric 76 mounted on axle 79, during initial rotation of eccentric 76 about axle 79 in an anti-clockwise direction, strip holder 75 moves downward in direction of arrow 200.

The initial contact between pusher surface 86 and push point 88 occurs once eccentric 76 has rotated sufficiently about axle 79 in an anti-clockwise direction, to cause strip holder 75 to move downwardly away from electrical connector 38 (Figure 21). The contact between pusher surface 86 on eccentric 76 with push point 88 of strip holder 75 then causes rotation of strip holder 75 in direction of arrow 100 (anti-clockwise) about axle 79. As further pressure is applied to push point 88 by pusher surface 86, strip holder 74 is caused to rotate about axle 79 until frame stop 83 makes contact with holder stop 85. At which point load channel 58 is presented substantially coplanar with incoming strip 10 from stack of strips 24.
When strip holder 75 has been moved through 90° relative to resiliently biased electrical connector 38, strip 10 may be pushed into load channel 58 by strip pusher 80, guided by delivery port 56 (not shown) (see Figure 22). When strip 10 has been pushed sufficiently into load channel 58, strip holder 75 is returned to a test position as eccentric 76 rotates in a clockwise direction about axle 79 (Figure 23). During the course of rotation, pusher surface 86 on eccentric 76 remains in physical contact with push point 88 of strip holder 75. When strip holder 75 has been returned to a position substantially coplanar with electrical connector 38 (Figure 24) strip 10 and more specifically contact electrodes 26 on strip 10 are aligned beneath resiliently biased electrical connectors 38. However, electrical and physical contact between contact electrodes 26 and electrical connector 38 only occurs when eccentric 76 has been further rotated in a clockwise direction about axle 79 such that the interaction between edge surface 92 of eccentric 76 and flat surface 90 of strip holder 75 occurs. The offset position of axle 79 within eccentric 76 causes strip holder 75 to be urged towards electrical connectors 38. Therefore electrode contacts 26 are also urged towards resiliently biased electrical connectors 38 (Figure 25). Thus, when eccentric 76 has been rotated sufficiently in a clockwise direction around axle 79, strip 10 is held in physical contact with electrical connector 38 for such time so as to allow a measurement of a fluid sample to be completed using the strip.

Figure 26 shows a strip 10, fill indicator window 22, contact electrodes 26, pin 96, slide 74, delivery port 56, strip holder 75, electrical connector 38, frame 81, channel 102. The perspective view of Figure 26 shows a rotatable test sensor port according to a fourth embodiment of the invention. Strip holder 75 contains resiliently biased electrical connectors 38 and delivery port 56 in a single component, unlike the previous embodiment wherein electrical connectors 58 were separate from strip holder 75. When in a test position, strip holder 75 and electrical connector 38 is substantially perpendicular to stack of strips 24 (not shown). In order to accept a strip 10 from a stack of strips 24 (not shown) strip holder 75 must therefore be moved through 90° so as to align delivery port 56 with a strip 10 as it is pushed from a stack of strips by pusher 80 (not shown).
Figure 27 shows the device of Figure 26 from a second perspective, wherein slide 74 has been removed to reveal frame 91. Strip holder 75 is rotatably mounted on pivot 73 of frame 91. Frame 91 is fixably attached to meter casing 4. The movement of eccentric pin 96 within channel 102 (Figure 28) as slide 74 moves in direction of arrow 98 causes strip holder 75 to rotate about pivot 73 of frame 91 in direction of arrow 100. Slide 74, which is directly attached to lifter 59 (not shown), is caused to move when a user activates strip load actuator 78. Therefore, when a user activates load actuator 78, strip holder 75 is initially rotated to align with the top of stack 24. Thus, when strip holder 75 has been moved through 90° in the direction of arrow 100, such that delivery port 56 is substantially aligned with stack of strips 24, pusher 80 may push a strip 10 from stack of strips 24.

When a strip 10 has been pushed from stack of strips 24 by pusher 80 into delivery port 56, physical and electrical contact occurs between electrical connector 38 and strip 10, and more specifically between electrode contacts 26 on strip 10 and electrical connector 38. Strip 10 is thus held in place within load channel 58 by resiliently biased electrical connector 38.

Once strip load actuator 78 has been extended to the point where a strip 10 has been correctly positioned beneath electrical connector 38, load actuator 78 is subsequently returned to an initial resting position. The consequence of which is to cause lifter 59 to move downwardly with respect to storage portion 77 as vial cap 84 is replaced on vial 82. Slide 74 moves concurrently with lifter 59 to effect rotation of strip holder 75 in direction of arrow 66. When load actuator 78 has returned to a resting position, strip 10 is presented to a user in a “flat” orientation in readiness to accept a sample. Strip 10 is therefore presented to the user of the device or meter in a position that will enable a sample to be applied such that the user is enabled to view the fill indicator window 22 while being able to follow any instructions provided on the visual display 6 of the meter or device 2.

Figure 30 shows a stack of strips 24, strip 10, sample application area 20. Arrow 100 indicates the direction of rotation about axis 110. The stack of strips 24 shown in Figure 30 indicates the relationship between the ends of a number of strips 10 and the
axis of rotation 110. Axis of rotation 110 relates to the first embodiment of the invention as described with respect to Figure 7 to Figure 16. A strip 10 is taken from the top of a stack of strips 24 into a rotatable port connector 33 (not shown). Strip 10 is then rotated about a central axis 110, thus moving the strip from an “on edge” orientation to a “flat” orientation, such that a user of a meter that incorporates such a strip rotation mechanism is able to view the fill indicator window and the visual display of the meter simultaneously.

The view of Figure 30 indicates that a strip 10 may be rotated within or about the confines of the dimensions of the end of the stack 24. Therefore, it may be possible to provide a rotation means that can accept a strip 10 from a stack of strips 24, which does not add to the overall dimensions of casing 4 of meter 2. The strip 10, shown in outline represented by a broken line, indicates the stages of rotation from an “edge” position (as in the stack) to a “flat” position (ready to accept a sample for testing). As strip 10 is rotated the major surface upon which is located fill indicator window 22 is moved such that it becomes substantially perpendicular with respect to the elongate edge of strip 10 (Figure 31).

Figure 32 shows a stack of strips 24, as depicted in Figure 30, wherein a rotation means according to a second embodiment of the invention, as described with reference to Figure 17 to Figure 19. A strip 10 is taken from a stack of strips 24 into a rotatable port connector 33 (not shown) in an “on edge” orientation. The strip is then rotated through 90° about one elongate edge to a “flat” orientation, such that the first major surface of the rotated strip is substantially aligned with the elongate edges of the remaining strips 10 in the stack of strips 24. The ends of the strip 10 shown by a broken line indicate the progress of strip rotation about axis 120 in direction of arrow 100. Axis 120 is substantially coincident with an edge of strip 10. As with the first embodiment of the invention, a strip is moved from an “on edge” orientation in the stack 24 to a “flat” orientation substantially within the confines of dimensions of the stack. Thus rotation about an axis 120 is within the scope of the present invention.

Figure 33 shows the stack of strips 24 shown in Figure 32, wherein the stack has been rotated to display an elongate edge of the strips 10. The strip 10 shown by a
broken line represents the "on edge" orientation, which is superimposed with a "flat" orientation, indicating the final position of the rotated strip prior to application of a sample from a user.

The process of dispensing a strip 10 from a stack of strips 24 and subsequently rotating the strip such that it is moved from a first position to a second position, wherein the first major surface of the strip becomes substantially perpendicular when in a second position compared with the first position when the strip is present in a stack of strips 24. The geometrical arrangement of the stack of strips 24 with associated rotatable port connector 33 is such that the overall dimensions of the casing 4 of meter 2 is not significantly increased compared with the embodiment shown in Figure 1 where the strip is dispensed in an "on edge" orientation, directly from the top of a stack of strips 24. The modified meter 2 that incorporates a rotatable port connector may thus present a dispensed strip to a user of the meter in a preferred orientation. Furthermore, the dimensions of the casing of the meter are not significantly increased.

Figures 17 to 33 show an embodiment in which the distance between axis of rotation of strip 10 and the strip 10 is kept as small as possible to maintain the compactness of the overall stack and rotation mechanism in combination.

Figure 34 shows an exploded diagram of a rotatable test sensor port connector (PC) 1001 according to a fifth embodiment of the invention. Figure 34 includes a main housing 1000, rotatable PC 1001, position control terminal 1002, test sensor port 1003, rotary barrel 1004, signal terminals 1006, slide block assembly 1008, cam follower 1010, rear cam housing 1012, cam track 1014, positional nails 1016, rear cover 1018, flexible circuit assembly 1020, fixing screws 1022.

Main housing 1000 provides structural support for rotatable PC 1001. Position control terminal 1002 is located within the periphery of main housing 1000. When rotatable PC 1001 is assembled position control terminal 1002 is located such that it will make electrical contact with positional nails 1016. Slide block assembly 1008 supports the signal terminals 1006. Slide block assembly 1008 and signal terminals 1006 are slidably mounted within rotary barrel 1004. Rotary barrel 1004 is rotatably
located within rear cam housing 1012. Positional nails 1016 are located at three individual locations within rear cover 1018, such that they define discrete regions on the perimeter of rear cover 1018. Flexible circuit assembly 1020 is fixedly attached on the rear most face of rear cover 1018. Flexible circuit assembly 1020 provides means to make electrical connection between the circuits of the meter 2 described with reference to Figure 1. More specifically, flexible circuit assembly 1020 contains conductive tracks (not shown) that form electrical connections with signal terminals 1006 and positional nails 1016.

When slide block assembly 1008 containing signal terminals 1006, has been located within rear cam housing 1012, fixing screws 1022 are used to attach flexible circuit assembly 1020 and rear cover 1018 to rotary barrel 1004. The assembled components thus form the rotatable PC 1001. The positional nails 1016 that terminate around the perimeter of rear cover 1018 will align with position control terminal 1002 when rotatable PC 1001 is turned within main housing 1000. The location of positional nails 1016 around the perimeter of rear cover 1018 are such that when each positional nail 1016 makes contact with position control terminal 1002 the position of rotary barrel 1004 within rear cam housing 1012 can be sensed.

Figure 35 shows a perspective view from the rear of an assembled rotatable PC 1001. Figure 35 includes main housing 1000, position control terminal 1002, signal terminals 1006, positional nails 1016, rear cover 1018, flexible circuit assembly 1020, fixing screws 1022, vias 1024, elongate portion 1028, strip entry channel 1029.

Flexible circuit assembly 1020 is fixedly attached to rear cover 1018 using double sided adhesive tape (not shown). Flexible circuit assembly 1020 contains several vias 1024 through which the terminal ends of signals terminals 1006 and positional nails 1016 extend. The terminal ends of positional nails 1016 and signal terminals 1006 that protrude through vias 1024 are soldered to individual conductive tracks (not shown) that are present on flexible circuit assembly 1020. The conductive tracks (not shown) embedded within flexible circuit assembly 1020 form electrical bridges between each respective via 1024 and the appropriate circuit within the meter 2. Thereby making the connection between signal terminals 1006, positional nails 1016, and the respective
circuit in the meter 2 necessary for correct operation of the measurement and control
circuits within the meter 2.

Rear cover 1018 has a series of gear teeth around a portion of the perimeter surface. Rear cover gear teeth 1026 provide means to actively drive the rotatable PC 1001
within main housing 1000. When rotatable PC 1001 is rotated within main housing
1000 positional nails 1016 will sequentially make electrical contact with positional
control terminal 1002. The location of positional nails 1016 around rotary barrel 1004
provide an indication of the rotational position of rotary barrel 1004 and therefore test
sensor port 1003 within main housing 1000. The meter can thus determine whether
rotatable PC 1001 is in a “resting” position, a “strip load” position or a “testing”
position (as will be described below with reference to Figures 46, 47, 48 and 49).

Flexible circuit assembly 1020 has an elongate portion 1028 that extends outwardly
from main housing 1000 when the rotatable PC 1001 is assembled. Elongate portion
1028 of flexible circuit assembly 1020 is used to make electrical contact with the
functional circuits of the meter 2 of which the rotatable PC 1001 is a component part.

Figure 36 shows a perspective view from the front of an assembled rotatable PC
1001. Figure 36 includes main housing 1000, rotatable PC 1001, position control
terminal 1002, test sensor port 1003, rotary barrel 1004, signal terminals 1006, elongate
portion 1028, protruding aperture 1030.

Rotary barrel 1004 is aligned with protruding aperture 1030 on the front face of
main housing 1000. When main housing 1000 is fixed within the casing 4 of meter 2
(as shown in Figure 1) protruding aperture 1030 integrates into the outer wall of case 4.
The uppermost surface of rotary barrel 1004 is thus presented as part of the external
surface of outer casing 4 of meter 2. Test sensor port 1003 is thus free to rotate within
the case 4 of meter 2. The signal terminals 1006 are visible within test sensor port
1003. Signal terminals 1006 make electrical contact with discrete electrode pads (not
shown) that are present on a test sensor (not shown).
Elongate portion 1028 of flexible circuit assembly protrudes beyond the outer perimeter of main housing 1000. Rear cover 1018 can be seen protruding beyond the elongate edges of main housing 1000. Rear cover gear teeth 1026 are visible on the right-hand side of the figure when the test sensor port 1003 is horizontal (as drawn) within main housing 1000. Position control terminal 1002 extends through the face of main housing 1000, wherein it is fixed. Interaction of position control terminal 1002 with positional nails 1016 provides an indication of the angular orientation of rotary barrel 1004 and thus test sensor port 1003 within main housing 1000.

Figure 37 shows an exploded view of slide block assembly 1008. Slide block assembly comprises cam follower 1010, pawl 1032, pawl pin 1033, pawl spring 1034, lead-in surface 1035, pawl axle 1036, pawl grip surface 1037, pawl axle mount 1038.

Pawl 1032 is rotatably fixed on pawl axle 1036. Pawl axle 1036 is located within pawl axle mount 1038. Pawl spring 1034 locates over pawl pin 1033 and fits within a recess (not shown) in slide block assembly 1008. Pawl 1032 can therefore be compressed upwardly into slide block assembly 1008 against pawl spring 1034. Lead-in surface 1035 of pawl 1032 is designed to allow an incoming test sensor 1040 to displace pawl 1032 upwardly into slide block assembly 1008. Pawl spring 1034 is compressed during insertion of a test sensor 1040 into rotatable PC 1001. Once a test sensor 1040 has been delivered past lead-in surface 1035, pawl spring 1034 decompresses, causing pawl 1032 to move downward. Pawl grip surface 1037 drops down behind a test sensor 1040 that has been correctly delivered into rotatable PC 1001. Pawl grip surface 1037 thus acts as a backstop within rotatable PC 1001. The function of pawl 1032 will be further described with relation to figures 38 to 40.

Figure 38 shows a cross sectional view through an assembled test sensor port connector. The assembled rotatable PC 1001 includes test sensor port 1003, rotary barrel 1004, signal terminal 1006, slide block assembly 1008, cam follower 1010, rear cam housing 1012, cam track 1014, rear cover 1018, strip entry channel 1029, pawl 1032, pawl pin 1033, pawl spring 1034, lead-in surface 1035, pawl axle 1036, pawl grip surface 1037, pawl axle mount 1038, test sensor 1040, direction of test sensor delivery 1042.
The cross section shows rotary barrel 1004 in a position ready to accept an incoming test sensor 1040. The cross sectional view shows a test sensor 1040 that has been pressed through rear cover 1018 and into contact with pawl 1032. Test sensor 1040 having made contact with lead-in surface 1035 of pawl 1032 has caused pawl 1032 to move upward. In so doing, pawl 1032 rotates about pawl axle 1036 compressing pawl spring 1034.

A test sensor 1040 is delivered from a stack of strips (not shown) that is contained within meter 2 in direction of arrow 1042. Test sensor 1040 initially enters strip entry channel 1029 of rotatable PC 1001 when it is delivered from a stack of strips (not shown). Strip entry channel 1029 has a tapered lead in to reduce the risk of a miss-fed test sensor 1040 from becoming jammed within the entrance of rotatable PC 1001.

Pawl 1032 is provided within rotatable PC 1001 to prevent a dispensed test sensor 1040 from being pushed back into the meter 2. Thus pawl 2 will act to stop either a used test sensor 1040 or other foreign object from being forced into meter 2 and therefore minimise potential risk of contamination or damage to the mechanism used to deliver a test sensor 1040 from an integral storage container (not shown).

Figure 39 shows the view of Figure 38 wherein test sensor 1040 has been fully inserted through rotary barrel 1004 to protrude beyond test sensor port 1003. Test sensor 1040 has been pushed past pawl 1032. Pawl spring 1034 has relaxed back to a non-compressed state and in so doing has pushed pawl 1032 downward. Pawl grip surface 1037 is now aligned behind test sensor 1040 such that test sensor 1040 is prevented from moving rearward in a direction opposite to arrow 1042. Therefore pawl grip surface 1037 acts to prevent a dispensed test sensor 1040 from being pushed back into the meter 2.

When test sensor 1040 has been fully inserted within rotary barrel 1004, signal terminal(s) 1006 make electrical connection with a series of contact pads on the test sensor 1040 (not shown). Rotary barrel 1004 is rotated through 90 degrees relative to
the “load” position to a “test” position. The test sensor 1040 is thus presented to a user on meter 2 in an orientation that is convenient for sample application.

The resilient bias of signal terminal(s) 1006 is sufficient to hold test sensor 1040 within rotary barrel 1004 during the testing procedure. Test sensor 1040 should therefore be held within rotary barrel 1004 for the duration of the test period. Therefore, should a user inadvertently tip meter 2 such that test sensor 1040 points downwards toward the floor, for example, the effect of gravity will not cause test sensor 1040 to fall from rotatable PC 1001.

Figure 40 shows the view of Figure 38 following completion of a test measurement. Rotary barrel 1004 has been rotated through a further 45 degrees relative to rear cover 1018, from a “test” position to a “discard” position. As rotary barrel 1004 turns within rear cam housing 1012, cam follower 1010 moves along cam track 1014. The consequence of which is to drive slide block assembly 1008 away from rear cover 1018 towards test sensor port 1003. When slide block assembly 1008 moves towards test sensor port 1003 pawl grip surface 1037 engages test sensor 1040 and urges it past signal terminal(s) 1006. Test sensor 1040 is thus disengaged from signal terminal(s) 1006. When slide block assembly 1008 has been driven to make contact with the front face of rotary barrel 1004, pawl 1032 will have pushed test sensor 1040 to the point where it can be discarded. A used test sensor 1040 may either be tipped directly into a waste disposal container under the influence of gravity. A user may also manually take a used test sensor 1040 from rotatable PC 1001 and dispose of it appropriately.

Figure 41 shows a perspective view of a sixth embodiment of the invention as described above with reference to Figures 37 to 40. Figure 41 shows a linear strip connector 2000, direction of test sensor delivery 2001, slide arm 2002, test sensor port 2004, return spring 2006, fixing point 2008.

It will be appreciated by one skilled in the art that linear strip connector 2000 serves a similar function to rotatable PC 1001 as described above with reference to Figure 35. Therefore, linear strip connector 2000 may be used in place of rotatable PC 1001 in a case where there is no requirement to rotate a test sensor prior to presentation
of the test sensor to a user. A test sensor (not shown) is delivered into the linear strip connector 2000 in direction of arrow 2001. Slide arm 2002 is provided to expel a used test sensor from the linear strip connector 2000 following completion of a test measurement.


When a test sensor (not shown) is introduced into strip entry channel 2022, ejector 2012 is displaced upwardly. Ejector 2012 pivots about ejector hinge 2016, against the resilient bias of ejector bias spring 2010. Ejector bias spring 2010 acts to keep ejector 2012 in a lowered position, in which it blocks the path between test sensor port 2004 and strip entry channel 2022.

The process of delivering a test sensor into a linear strip connector prior to making a test measurement and the subsequent removal of a used test sensor following completion of a test measurement will be described below with reference to Figures 43, 44, 45 and 46.

Figures 43 to 46 show cross sectional views through the linear strip connector 2000 of Figure 41. Figures 43 to 46 show linear strip connector 2000, slide arm 2002, test sensor port 2004, return spring 2006, ejector bias spring 2010, ejector 2012, end stop 2014, ejector groove 2017, test sensor 2018, signal terminal 2020, strip entry channel 2022, lead-in 2024, push point 2026.
Figure 39 shows a linear strip connector 2000 at the onset of delivery of a test sensor 2018 from a storage vial (not shown), for example, that is housed within the meter 2 of which the linear strip connector 2000 is an integral component part. Test sensor 2018 initially enters strip entry channel 2022. Strip entry channel 2022 has a tapered entry to accommodate slight variations in the alignment of linear strip connector 2000 with the storage container in which test sensors 2018 are stored within the meter 2. Thus, strip entry channel 2022 is shaped to minimise potential jamming of a miss-fed test sensor 2018 during delivery from the storage vial (not shown).

Ejector 2012 is located at the proximal end of ejector groove 2017 in contact with end stop 2014. Return spring 2006 is in a relaxed state. The spring constant of return spring 2006 is such that in a relaxed state, return spring 2006 applies sufficient force to ejector 2012 to keep ejector 2012 at a proximal position within ejector groove 2017. Ejector 2012 is thus held in contact with end stop 2014 by return spring 2006 during loading of a test sensor 2018 into linear strip connector 2000 and during the process of making a test measurement.

Figure 44 shows the passage of a test sensor 2018 beneath ejector 2012. When test sensor 2018 makes initial contact with lead-in 2024, ejector 2012 is deflected upwardly against the resilient bias of ejector bias spring 2010. The upward deflection of ejector 2012 by incoming test sensor 2018 causes rotation of ejector 2012 about ejector hinge 2016 (not shown). Ejector 2012 is displaced sufficiently to permit transit of test sensor 2018 from strip entry channel 2022 to test sensor port 2004. Return spring 2006 ensures that ejector 2012 remains at the proximal end of ejector groove 2017 while test sensor 2018 is pushed through strip entry channel 2022.

Although test sensor 2018 has pushed ejector 2012 upwardly, it has yet to make contact with signal terminal(s) 2020. Test sensor 2018 must therefore be pushed into strip entry channel 2022 with sufficient force so as to overcome the resilient force of both ejector bias spring 2010 and signal terminals(s) 2020.
Figure 45 shows a test sensor 2018 in a test position. Test sensor 2018 has been pushed out through test sensor port 2004, such that a sample application region (not shown) is presented to a user. Once test sensor 2018 has been pushed beyond ejector 2012, ejector bias spring 2010 causes ejector 2012 to move downward to a resting position. When ejector 2012 is in a rest position push point 2026 is aligned directly behind test sensor 2018. Push point 2026 can thus prevent a test sensor 2018, or other foreign object, from being forced rearward through test sensor port 2004 into the meter. Thus push point 2026 can prevent potential damage of the test sensor feed mechanism (not shown).

When test sensor 2018 has been pushed through strip entry channel 2022 beyond ejector 2012, a series of electrode contact points (not shown) on test sensor 2018 make physical and electrical contact with signal terminal(s) 2020. The resilient bias of signal terminal(s) 2020 applies an upward force to test sensor 2018. Thus test sensor 2018 is held firmly within test sensor port 2004. Therefore if a user were to inadvertently tip the meter during use test sensor 2018 would not fall from the test sensor port 2004.

Once a test measurement has been completed a used test sensor 2018 can be automatically ejected from the linear strip connector 2000. A user of meter 2 would apply a force to slide arm 2002, causing ejector 2012 to move within ejector groove 2017. Slide arm 2002 may either protrude directly through the outer case 4 of meter 2 such that a user can directly take hold of it. Alternatively, a slider (not shown) may be provided in the outer case 4 of meter 2 that integrates with slide arm 2002.

When a user has completed a test measurement (Figure 46) the used test sensor 2018 is discarded into a suitable waste disposal unit. Sufficient force must be applied to slide arm 2002 to cause compression of return spring(s) 2006 between ejector 2012 and distal end of ejector groove 2017. As ejector 2012 is pushed towards test sensor port 2004 by the user, initial compression of return spring(s) 2006 occurs prior to interaction between push point 2026 and test sensor 2018. The force required to compress return spring(s) 2006 is such that the risk of accidental ejection of a test sensor from linear strip connector 2000 is low. Therefore during use a test sensor should not be accidentally dislodged from signal connector(s) 2020.
Continued application of motive force to slide arm 2002 causes return spring(s) 2006 to be completely compressed between ejector 2012 and distal wall of ejector groove 2017. The consequence of which is to disengage test sensor 2018 from signal terminal(s) 2020. Test sensor 2018 is therefore no longer physically held within linear strip connector 2000. The used test sensor 2018 can therefore be discarded into a suitable waste container under the action of gravity.

Once a used test sensor 2018 has been removed from test sensor port 2004, and the user has removed the applied force from slide arm 2002, ejector 2012 is returned to the proximal end of ejector groove 2017 as return spring(s) 2006 expand to a relaxed state. End stop 2014 prevents return spring(s) 2006 from driving ejector 2012 beyond ejector groove 2017. The linear port connector 2000 is therefore returned to a state where it is ready to accept a further test sensor 2018 prior to conducting another test measurement.

Figure 47 shows a perspective view that reveals the relationship between rear cam housing 1012 and slide block assembly 1008. Figure 47 includes position control terminal 1002, test sensor port 1003, rotary barrel 1004, slide block assembly 1008, cam follower 1010, rear cam housing 1012, cam track 1014, rear cover 1018, test sensor 1040, cam follower home stop 1041, cam follower test stop 1043, first drive cog 1044, cam follower end stop 1045.

Rear cover 1018 is fixedly attached to rotary barrel 1004. Rotary barrel 1004 is free to rotate within rear cam housing 1012. Slide block assembly 1008 is slidably mounted within rotary barrel 1004. Cam follower 1010 is located on the circumference of slide block assembly 1008. Thus when first drive cog 1044 acts upon rear cover 1018, rotary barrel 1004 and thus slide block assembly 1008 are caused to rotate within rear cam housing 1012. The movement of rotary barrel 1004 within rear cam housing 1012 causes cam follower 1010 to move around cam track 1014. The movement of cam follower 1010 around cam track 1014 effects the axial movement of slide block assembly 1008 within rotary barrel 1004. During rotation of rotary barrel 1004 within rear cam housing 1012, slide block assembly 1008 moves from a first position where cam follower 1010 is located in close proximity to rear cover 1018 to a second position
where cam follower 1010 is located in close proximity to the front surface of rotary barrel 1004 in which test sensor port 1003 is present.

Slide block assembly 1008, which includes pawl 1032 (not visible), slidably moves within rotary barrel 1004 when rear cover 1018 is driven by first gear cog 1044. The movement of slide block assembly 1008 and pawl 1032 from a first position, wherein cam follower 1010 is closest to rear cover 1018, to a second position, wherein cam follower 1010 is furthest from rear cover 1018, causes pawl grip surface 1037 to interact with a test sensor 1040 present in rotatable PC 1001. Initially cam follower 1010 is in contact with cam follower home stop 1041. Test sensor port 1003 and therefore strip entry channel 1029 (not visible) are oriented to receive an incoming test sensor 1040 from a stack of sensors (not shown) held within a cassette within the meter 2. The initial rotation of rear cover 1018 and hence movement of cam follower 1010 around cam track 1014 does not effect the position of slide block assembly 1008. During the initial rotation of rotatable PC 1001, cam follower 1010 travels through 90 degrees around cam track 1014, relative to cam follower home stop 1041. Cam follower 1010 then rests at cam follower test stop 1043.

When cam follower 1010 is resting at cam follower test stop 1043 test sensor port 1003 is aligned in a “test” position. A test sensor 1040 is thus presented to a user of the meter 2 in an orientation that is amenable to sample application from a finger tip, for example. The fill indicator window (not shown) on the test sensor 1040 is visible simultaneously with the visual display (not shown) on the meter 2. Cam track 1014 has a flat profile that is substantially parallel with rear cover 1018 between cam follower home stop 1041 and cam follower test stop 1043. Thus during rotation of rotary barrel 1004 through an initial 90 degree sweep there is no net axial movement of slide block assembly 1008 within rotary barrel 1004.

Once a test measurement has been successfully completed, cam follower 1010 is rotated further around cam track 1014, between about 90 and 135 degrees relative to cam follower home stop 1041. Cam track 1014 has a gradient profile between cam follower test stop 1043 and cam follower end stop 1045 that causes a net axial movement of approximately 3 mm of slide block assembly 1008 within rotary barrel
1004. Thus, following completion of a test measurement on test sensor 1040, a used test sensor 1040 is expelled from rotatable PC 1001 when slide block assembly 1008 is driven forward towards test sensor port 1003. The movement of cam follower 1010 along cam track 1014 between cam follower test stop 1043 towards cam follower end stop 1045 causes slide block assembly 1008 to move within rotary barrel 1004. The effect of which is to cause pawl 1032 to push test sensor 1040 out of the rotatable PC 1001. Test sensor 1040 is thus disengaged from signal terminal(s) 1006, which permits displacement of a used test sensor 1040 directly into a waste collection vessel. A user of meter 2 within which the rotatable PC 1001 is present is therefore not required to manually handle a test sensor 1040.

Figure 48 shows a perspective view of a rotatable PC 1001 with drive motor 1052 according to a seventh embodiment of the invention. Figure 48 shows main housing 1000, signal terminals 1006, positional nails 1016, rear cover 1018, flexible circuit assembly 1020, elongate portion 1028, strip entry channel 1029, first drive cog 1044, first drive cog axle 1046, drive shaft groove 1048, drive motor fixing point 1050, drive motor 1052, drive motor fixing screw 1054, drive shaft 1056, drive shaft collar 1058.

Main housing 1000 supports rotatable PC 1001, drive motor 1052 and first drive cog 1044. Drive motor 1052 is attached to main housing 1000 by drive motor fixing screws 1054. Drive motor fixing screws 1054 grip main housing 1000 at drive motor fixing points 1050, when drive motor fixing screws 1054 are screwed into drive motor 1052. Drive shaft collar 1058 is supported by drive shaft groove 1048 when drive motor fixing screws 1054 have been tightened against drive motor fixing points 1050. Drive motor 1052 is therefore held firmly in place with relation to main housing 1000.

First drive cog 1044 is mounted on first drive cog axle 1046. First drive cog 1044 integrates drive shaft 1056 with rear cover 1018. Thus first drive cog 1044 transmits rotational movement from drive shaft 1056 to rear cover 1018. The drive shaft 1056 rotates at approximately 8000 rpm. The gear ratio of first drive cog 1044 is such that rear cover 1018 rotates at approximately 80 rpm. Therefore a test sensor 1040 will also rotate at approximately 80 rpm within rotatable PC 1001. The relatively slow rate of rotation of test sensor 1040 within rotatable PC 1001 should minimise any risk of
damage that could occur to either the test sensor 1040 or rotatable PC 1001 in the event that a test sensor 1040 is incorrectly fed into rotatable PC 1001.

Figure 49 shows a rotatable PC 1001 according to an eighth embodiment of the invention. Figure 49 shows main housing 1000, rotatable PC 1001, flexible circuit assembly 1020, fixing screws 1022, first drive cog 1044, drive shaft groove 1048, drive motor 1052, drive shaft 1056, drive shaft collar 1058, second drive cog 1060, drive motor housing 1062, drive motor housing screws 1064, first drive cog mount 1066, second drive cog amount 1068.

Main housing 1000 provides support means to accommodate drive motor 1052, first drive cog 1044 and second drive cog 1060. Additionally drive motor housing 1062 is provided to encase and support drive motor 1052, first drive cog 1044 and second drive cog 1060. Main housing 1000 and drive motor housing 1062 contain drive shaft groove 1048, and two pairs of holes, first drive cog mount 1066 and second drive cog mount 1068 respectively. Drive motor 1052 locates within drive motor housing 1062, with drive shaft collar 1058 locating within drive shaft groove 1048. First drive cog 1040 locates within first drive cog mount 1066 and second drive cog 1060 locates within second drive cog mount 1068. Drive motor housing screws 1064 are used to fix drive motor housing 1062 to main housing 1000. The fixing of drive motor housing 1062 to main housing 1000 thus locks drive motor 1052, first drive cog 1044 and second drive cog 1060 in place against rear cover 1018. Drive motor 1052 can thus be used to drive rear cover 1018 between a “load” position, “test” position and “discard” position respectively during the process of making a measurement.

First drive cog 1044 and second drive cog 1060 rotate within first drive cog mount 1066 and second drive cog mount 1068 respectively. Second drive cog 1060 comprises two gears with a major and minor diameter. The major diameter interacts with drive shaft 1056 and the minor diameter interacts with first drive cog 1044. First drive cog 1044 interacts with rear cover 1018. Thus mechanical energy is transmitted from drive motor 1052 through first drive cog 1044 and second drive cog 1060 to rear cover 1018. Drive shaft 1056 rotates at approximately 8000 rpm and through the gearing of first drive cog 1044 and second drive cog 1060, rear cover rotates at approximately 42 rpm.
Therefore movement of a test sensor 1040 within rotatable PC 1001 occurs at a relatively low speed, thus minimising potential for damage should a test sensor 1040 become jammed in the rotatable PC 1001. Furthermore, in the event that a user should accidentally touch test sensor 1040 while it is being dispensed and rotated from a “load” to a “test” orientation, potential damage to the dispenser mechanism should be minimal.

Figure 50 shows the rotatable PC 1001 shown in Figure 49 in the absence of main housing 1000 and drive motor housing 1062. Figure 50 shows position control terminal 1002, test sensor port 1003, rotary barrel 1004, slide block assembly 1008, cam follower 1010, cam track 1014, rear cover 1018, cam follower home stop 1041, cam follower test stop 1043, first drive cog 1044, cam follower end stop 1045, drive motor 1052, drive shaft 1056, second drive cog 1060.

Rotatable PC 1001 is shown in a resting position in the absence of a test sensor 1040. Cam follower 1010 is at cam follower end stop 1045, in which position it would not be possible to introduce a test sensor 1040 into the rotatable PC 1001. Position control terminal 1002 in combination with positional nails 1016 is used to determine the orientation of rotary barrel 1004 within rear cam housing 1012. Three positional nails 1016 exist around the perimeter of rear cover 1018. Positional nails 1016 are aligned around rear cover 1018 to coincide with cam follower home stop 1041; cam follower test stop 1043 and cam follower end stop 1045 respectively. When physical/electrical contact occurs between position control terminal 1002 and positional nails 1016 a signal is produced that indicates the orientation of rotatable PC 1001 to the central processor unit of the meter 2 (not shown). Thus the central processor of meter 2 is able to maintain a record of the location of strip entry channel 1029 with respect to the integral storage vessel (not shown) used to contain test sensors 1040. Central processor (not shown) can therefore invoke the necessary control algorithms required for functional operation of meter 2.

Figure 51 shows the view of Figure 50 wherein rotary barrel 1004 has been driven to a “load” position and a test sensor 1040 has been delivered into rotatable PC 1001. Cam follower 1010 is at cam follower home stop 1041. Slide block assembly 1008 has
been driven to the rear portion of rotary barrel 1004, such that pawl 1032 is aligned directly behind strip entry channel 1029. Rotatable PC 1001 is thus oriented to accept an incoming test sensor 1040 from a stack of test sensors (not shown) housed within meter 2. Once a test sensor 1040 has been delivered past pawl 1032 to the point that signal terminals 1006 have made contact with electrode contact terminals (not shown) on test sensor 1040, rotary barrel 1004 is then driven to a “test” position.

Rotation of rotatable PC 1001 to a “test” position is shown in Figure 52. Cam follower 1010 travels round cam track 1014 until it reaches cam follower test stop 1043. Position control terminal 1002 interacts with positional nail 1016 that indicates rotary barrel 1004 is in a “test” position. The electrical power supply to drive motor 1052 is thus removed at this point. The relatively low rotational speed of rotary barrel 1004 compared to that of drive shaft 1056 permits greater control over the “stopping” of rotary barrel 1004 at the respective locations involved with conducting a test measurement. Therefore the risk of a test sensor 1040 being miss-fed into rotatable PC 1001 is relatively low. The tapered lead-in of strip entry channel 1029 is sufficient to accommodate slight positional variation of rotatable PC 1001 with respect to the integral supply of test sensors 1040.

When rotary barrel 1004 has been rotated to a “test” position, test sensor 1040 is presented to a user of meter 2 in an orientation that is convenient for sample application. The sample application window (not shown) on test sensor 1040 is clearly visible to a user. The user can also clearly see the visual display on the meter 2 at the same time as the sample application window. Thus a user is able to follow any instructions presented on the visual display of the meter 2 while applying a sample of blood from a finger tip to test sensor 1040, for example.

Once a sample has been successfully applied to test sensor 1040 and a result presented to the user indicating the level of analyte, e.g. glucose, present in the sample of blood previously applied to test sensor 1040, the user is prompted to discard the used test sensor 1040. A used test sensor 1040 is discarded from the rotatable PC 1001 automatically. In one embodiment the user is prompted to press a button on the meter 2 that invokes the “discard” cycle.
Figure 53 shows the view of Figure 50 prior to disposal of a now used test sensor 1040. Cam follower 1010 has moved around cam track 1014 from cam follower test stop 1043 to cam follower end stop 1045. The gradient profile of cam track 1014 between cam follower test stop 1043 and cam follower end stop 1045 is such that slide block assembly 1008 is slidably moved within rotary barrel 1004. As cam follower 1010 moves around cam track 1014 between cam follower test stop 1043 and cam follower end stop 1045, slide block assembly moves through a distance of about 3 mm from rear cover 1018 to the front face of rotary barrel 1004 in which test sensor port 1003 is present. When slide block assembly 1008 moves within rotary barrel 1004, the displacement of test sensor 1040 from beneath signal terminal(s) 1006 occurs. Pawl 1032, and more specifically pawl grip surface 1037, pulls test sensor 1040 forward within rotary barrel 1004, such that test sensor 1040 is displaced out through test sensor port 1003. A used test sensor 1040 may thus be expelled directly into a waste disposal vessel without the user having to manually handle the test sensor 1040.

Once the used test sensor 1040 has been discarded, the meter 2 powers off, leaving rotary barrel 1004 in the "rest" position of Figure 50. Cam follower 1010 thus remains at cam follower end stop 1045 until the meter is switched on prior to making a further measurement. In which case the movement of rotatable PC 1001 follows the sequence outlined with reference to Figures 48 to 51.

Figure 54 shows rear cover 1018 with flexible circuit assembly 1020. Figure 54 shows position control terminal 1002, positional nails 1016, rear cover 1018, flexible circuit assembly 1020, vias 1024, elongate portion 1028, strip entry channel 1029, rear cover fixing screw holes 1070.

Rear cover 1018 provides support means for positional nails 1016. Positional nails 1016 in contact with position control terminal 1002 provide an indication of the rotational position of the rotary barrel 1004 within rear cam housing 1012. An electrical signal is generated at the central processor unit of meter 2 that indicates the position of rotary barrel 1004 and hence the orientation of test sensor port 1003 when position control terminal 1002 makes contact with each respective positional nail 1016.
Meter 2 is thus able to control the dispensing of a test sensor 1040 from a store of test sensors within the meter 2. A test sensor will only be dispensed into rotatable SCP 1001 when cam follower 1010 is located at cam follower home stop 1041.

Flexible circuit assembly 1020 is fixed on to the outermost surface of rear cover 1018. A series of conductive tracks (not shown) extend from elongate portion 1028 and terminate at a series of vias 1024 within flexible circuit assembly 1020. The ends of signal terminals 1006 extend beyond rear cover 1018, protruding through separate vias 1024. Electrical connections are formed between separate conductive tracks (not shown) on flexible circuit assembly 1020 and the ends of signal terminals 1006 at the junction with separate vias 1024. Similarly, positional nails 1016 protrude through separate vias 1024 in flexible circuit assembly 1020. Electrical connections are also formed between positional nails 1016 with separate conductive tracks (not shown) on flexible circuit assembly 1024. Elongate member thus provides a means to bridge the main circuits of the meter 2 with signal terminals 1006 and positional nails 1016. Furthermore, elongate member 1028 is provided to overcome the fact that rear cover 1018 rotates through an arc of about 135 degrees when rotary barrel 1004 is driven from "load" position, past "test" position, to "eject" position. The flexibility of elongate portion 1028 thus maintains the integrity of the electrical connections between a test sensor 1040 and the meter circuits during the process of making a test measurement.

It will be recognized that equivalent structures may be substituted for the structures illustrated and described herein and that the described embodiment of the invention is not the only structure that may be employed to implement the claimed invention. In addition, it should be understood that every structure described above has a function and such structure can be referred to as a means for performing that function.

While preferred embodiments of the present invention have been shown and described herein, it will be obvious to those skilled in the art that such embodiments are provided by way of example only. Numerous variations, changes, and substitutions will now occur to those skilled in the art without departing from the invention.
CLAIMS:

1. Apparatus for positioning a test strip in a test strip connector and ejecting a used test strip from said strip port connector, said apparatus comprising:
   a slot in said strip port connector;
   a movable ejector assembly adapted to move out of said slot when a first end of said test strip is moved into said slot, said movable ejector assembly being further adapted to move back into said slot when a second end of said strip passes said moveable ejector; and
   a plurality of contact electrodes positioned in said slot, said contact electrodes being adapted to move out of said slot when said first end of said test strip is moved into said slot, said plurality of electrodes being further adapted to maintain contact with said strip as said strip is moved through said slot and to contact one or more electrical contacts on said test strip.

2. A method of positioning, reading and ejecting a test strip in a test strip port having a first opening, a slot, a second opening, a moveable ejector assembly and a plurality of contact electrodes, said method comprising the steps of:
   sliding said test strip into a first end of said slot;
   pushing said ejector assembly out of said slot as said test strip moves through said slot;
   pushing said electrical contacts out of said slot as said test strip moves through said slot;
   moving said ejector assembly into said slot and past said ejector assembly;
   positioning said electrical contacts to contact electrical connectors on said test strip;
   taking a measurement; and
   pushing said test strip out of said slot using said ejector assembly.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 GOIN33/487 BOIL11/00

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 7 BOIL GOIN

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

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

EPO-Internal, PAJ, BIOSIS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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* Special categories of cited documents:

* The document contains general or specialized technical information relevant to the invention but does not define an invention itself.

X The document defines the general state of the art to which the invention relates.

* The document is 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: 30 September 2005

Date of mailing of the international search report: 10/10/2005

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