(12) STANDARD PATENT (11) Application No. **AU 2013282300 B2**
(19) AUSTRALIAN PATENT OFFICE

(54) Title
A chemical indicator device

(51) International Patent Classification(s)
G01N 21/25 (2006.01) ***G01N 30/74*** (2006.01)
G01N 21/01 (2006.01)

(21) Application No: **2013282300** (22) Date of Filing: **2013.06.28**

(87) WIPO No: **WO14/005112**

(30) Priority Data

(31) Number	(32) Date	(33) Country
61/665,584	**2012.06.28**	**US**

(43) Publication Date: **2014.01.03**
(44) Accepted Journal Date: **2017.03.09**

(71) Applicant(s)
Fluoresentric, Inc.

(72) Inventor(s)
Fugere, Nicole A.;Caplin, Brian E.

(74) Agent / Attorney
Pizzeys Patent and Trade Mark Attorneys Pty Ltd, PO Box 291, WODEN, ACT, 2606, AU

(56) Related Art
US 2006/0120566 A1
DE 202008007512 U1
WO 2002/068932 A2

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 January 2014 (03.01.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/005112 A1

(51) International Patent Classification:
G01N 21/25 (2006.01) *G01N 21/01* (2006.01)
G01N 30/74 (2006.01)

(21) International Application Number:
PCT/US2013/048750

(22) International Filing Date:
28 June 2013 (28.06.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/665,584 28 June 2012 (28.06.2012) US

(71) Applicant: **FLUORESENTRIC, INC.** [US/US]; 2700 Homestead Road, Park City, UT 84098 (US).

(74) Agent: **Lang, Wesley M.**; P.O. Box 672, Kaysville, UT 84037 (US).

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

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

Published:

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

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

WO 2014/005112 A1

(54) **Title**: A CHEMICAL INDICATOR DEVICE

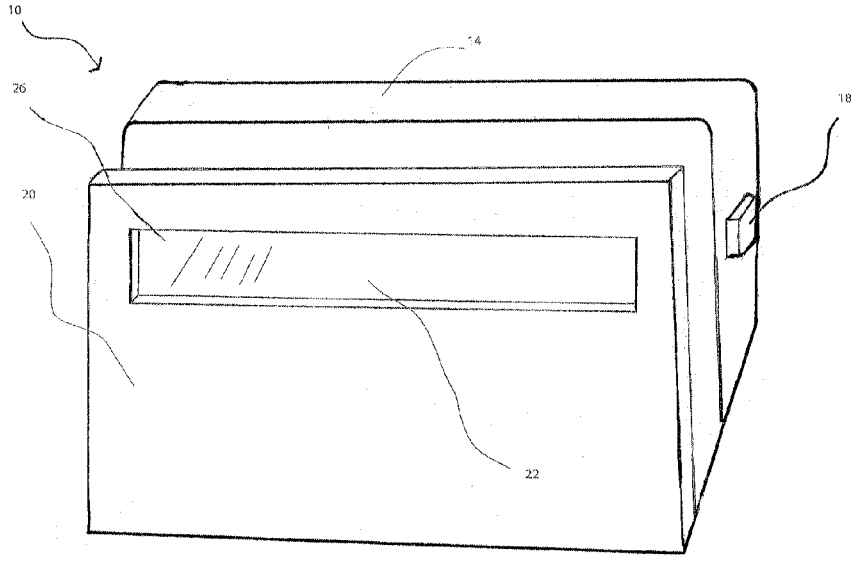

FIG. 1

(57) **Abstract**: A chemical indicator device comprising a housing that comprises a viewing port, a means to provide illumination, and test tube wells so configured such that the observer views the test tubes from the side.

A CHEMICAL INDICATOR DEVICE

A CHEMICAL INDICATOR DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 61665584 filed June 28, 2012 in the United States Patent and Trademark Office which is hereby incorporated by reference herein in its entirety, including but not limited to those portions that specifically appear hereinafter, the incorporation by reference being made with the following exception: In the event that any portion of the above-referenced applications are inconsistent with this application, this application supersedes said above-referenced application.

.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable.

BACKGROUND

1. The Field of the Present Disclosure.

[0001] This disclosure relates generally to a side view chemical indicator device. More particularly, but not necessarily entirely, this disclosure relates to a device for providing a simple, portable, low cost device for detecting the presence of a chemical indicator in reaction vessel.

2. Description of Related Art.

[0002] Scientific processes have long been assisted by readouts that result from illumination of the chemical compound in question by electromagnetic radiation of various wavelengths. For example, in the field of DNA amplification various fluorescent dyes and fluorescent probes are utilized to determine whether the DNA sequence of interest was amplified. Depending on the type of fluorescent dye or fluorescent probe used, the fluorescence is revealed by exposing the fluorescent dye or fluorescent probe in question to appropriate electromagnetic radiation and viewing the resulting fluorescence through a colored filter.

[0003] This is the standard technology used in analyzing the products of PCR amplification. PCR amplification is generally performed in miniature test tubes. Because PCR may take hours to perform, it is generally most efficient and hence, preferable, to carry out numerous PCR reactions simultaneously, in a batch. In order to accomplish this, multiple reactions are carried out simultaneously in a collection of test tubes. Because of the space requirements for PCR devices, the batches of test tubes are most commonly arranged in a square or circular configuration.

[0004] The square or circular configuration of test tubes used in traditional PCR thermocycling requires any visual fluorescence detection be performed by viewing the test tubes from above with the light source

generally located below the test tubes or vice verse. This is a less than ideal arrangement for detecting fluorescence because the light coming from below because the light is shining is the viewer's eyes. This tends to wash out much of the fluorescence, making differences in fluorescence difficult to detect. Visual detection is better performed when the test tubes are viewed from a more or less perpendicular angle to the direction of the light illuminating the test tubes. However, the arrangement of the test tubes in the traditional square or rectangular configuration renders viewing from the side difficult, if not impossible, due to the fact that the test tubes closest to the viewer tend to block the more distal test tubes from the viewer's vision.

[0005] With newer faster methods to amplify DNA it is not necessary to perform amplification in large batches. Smaller batches of DNA can be amplified cost effectively with newer amplification methods. This allows for the test tubes to be arranged in a row or in a few staggered rows. In turn, this allows for the ability to view the test tubes from the side, or from an angle that is more or less perpendicular to the direction of the illumination.

[0006] Thus, the following specification discloses a human eye readable chemical and biochemical detector for qualitative and quantitative detection.

[0007] This detector provides quantitative, and qualitative detection of fluorescent, phosphorescent, luminescent, electrochemical, or colorimetric results. The device is also adaptable to multiple color reactions, which include duplex, triplex, and higher order multiplex reactions. In one example for fluorescence readouts the device would be configured to use reporter dye matched excitation source(s) and emission matched result(s) filtering. reactions using reporter dye matched excitation sources and emission matched results filtering.

[0008] The detector is designed to be adaptable to whichever format of chemical or biochemical readout is required for the existing test. The flexibility of the system rests in two design features of the device:1) user based chemistry and biochemistry detection choices are numerous as the device can be readily adapted any desired illumination source and coupled with any desired filtering method. The combination of illumination choices and indicator filtering enables multiple possible combinations of fluorescent, phosphorescent, luminescent, or colorimeter indicators to be configurable within the detector.

[0009] This device enables a wide range of possible wavelengths of light to be used in combination with fluorophores and detection filtering either on the device, on the viewer (glasses) or both.

[0010] The features and advantages of the present disclosure will be set forth in the description which follows, and in part will be apparent from

the description, or may be learned by the practice of the present disclosure without undue experimentation. The features and advantages of the present disclosure may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The features and advantages of the disclosure will become apparent from a consideration of the subsequent detailed description presented in connection with the accompanying drawings in which:

FIG. 1 is a perspective view of the device;

FIG. 2 is an exploded view of the device;

FIG. 3 is a cutaway view of the device;

FIG. 4 is a cutaway view of another embodiment of the device containing heat blocks;

FIG. 5 is a top view of another embodiment of the device having rows of holders.

FIG. 6 is a side view of another embodiment of the device having a rotatable window.

DETAILED DESCRIPTION

[0012] For the purposes of promoting an understanding of the principles in accordance with the disclosure, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the disclosure is thereby intended. Any alterations and further modifications of the inventive features illustrated herein, and any additional applications of the principles of the disclosure as illustrated herein, which would normally occur to one skilled in the relevant art and having possession of this disclosure, are to be considered within the scope of the disclosure claimed.

[0013] Before the present invention is disclosed and described, it is to be understood that this disclosure is not limited to the particular configurations, process steps, and materials disclosed herein as such configurations, process steps, and materials may vary somewhat. It is also to be understood that the terminology employed herein is used for the purpose of describing particular embodiments only and is not intended to be limiting since the scope of the present disclosure will be limited only by the appended claims and equivalents thereof.

[0014] Any publications and other reference materials referred to herein to describe the background of the disclosure, and to provide additional detail regarding its practice, are hereby incorporated by

reference herein in their entireties, with the following exception: In the event that any portion of said reference materials is inconsistent with this application, this application supersedes said reference materials. The reference materials discussed herein are provided solely for their disclosure prior to the filing date of the present application. Nothing herein is to be construed as a suggestion or admission that the inventors are not entitled to antedate such disclosure by virtue of prior disclosure, or to distinguish the present disclosure from the subject matter disclosed in the reference materials.

[0015] It must be noted that, as used in this specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise.

[0016] In describing and claiming the present disclosure, the following terminology will be used in accordance with the definitions set out below.

[0017] As used herein, the terms “comprising,” “including,” “containing,” “characterized by,” and grammatical equivalents thereof are inclusive or open-ended terms that do not exclude additional, un-recited elements or method steps.

[0018] As used herein, the phrase “consisting of” and grammatical equivalents thereof exclude any element, step, or ingredient not specified in the claim.

[0019] As used herein, the phrase “consisting essentially of” and grammatical equivalents thereof limit the scope of a claim to the specified materials or steps and those that do not materially affect the basic and novel characteristic or characteristics of the claimed disclosure.

[0020] As used herein, the term "proximal" shall refer broadly to the concept of a nearest portion.

[0021] As used herein, the term "distal" shall generally refer to the opposite of proximal, and thus to the concept of a further portion, or a furthest portion, depending upon the context.

[0022] As used herein, the phrase "in an at least partially proximal-to-distal direction" shall refer generally to a two-dimensional concept of direction in which the "proximal-to-distal" direction defines one direction or dimension. An item that extends in a non-parallel direction with respect to the "proximal-to-distal" direction, that is, at a non-straight angle thereto, thereby involves two components of direction, one of which is in the "proximal-to-distal" direction and the other being in a direction orthogonal to the "proximal-to-distal" direction.

[0023] Fig.1 depicts a portable, hand held, battery operated, device 10 for observation of the visual signal of a chemical indicator. As depicted in Fig. 1, the device comprises a body 14. In one embodiment, the body 14 is sized and shaped to be readily held in the individual user's hand. The body 14 comprises an on/off switch 18 that activates the illumination feature (not shown) of the device 10. The device 10 further comprises a shield 20. The shield 20 removably attaches to the body 14. The removable shield 20 comprises an aperture 22. This aperture 22 is sized and shaped to receive a window 26. This window 26 may be comprised of glass, plastic, mica, any polymer, or other composite material known to those of ordinary skill in the art. The window 26 may be either clear or opaque. The window may be colored. In the embodiment depicted, the window 26 is permanently affixed to the shield 20. The shield 20 is removable from the body 14. In this embodiment, multiple shields 20 may be used, with each shield 20 possessing a window 26 of a different color. This embodiment permits the user to substitute windows 26 with different colors by attaching different shields 20 to the body 14. Although the power source in the embodiment depicted in Fig.1 is a battery, the power source could be alternating current from a conventional wall socket, a solar panel or any other power source known to those of ordinary skill in the art.

[0024] In yet another embodiment, the shield 20 is permanently affixed to the body 10. In this embodiment, the window 26 is removably attached to the shield 20. This permits the user to use windows 26 of different

colors by removing the window 26 currently in place and substituting a window 26 of the desired color.

[0025] Fig. 2 depicts an exploded view of the device 10. The body 14 comprises at least one test tube housing 40. The at least one test tube housing 40 is more or less hollow and comprises wells 34 sized and shaped to receive test tubes 38. The test tubes 38, comprise lips at their open ends that are larger in diameter than the diameter of the wells 34. When the test tubes 38 are inserted into the wells 34, the lips prevent the test tubes 38 from transiting all the way through the well 34. Thus, the test tube housing 40 and wells 34 provide a structure to suspend and maintain the test tubes in the proper position to be illuminated and viewed by the observer.

[0026] The test tube housing 40 comprises an opening 30 that permits a view into the interior of the test tube housing 40. The opening 30 is located so as to align with the aperture 22 in the shield 20 such the user is afforded a clear view into the interior of the test tubes housing 40. The aperture 22 as well as the opening 30 are situated such that at least a portion of the test tubes 38 are visible to the viewer so that the viewer, when looking through the window views the test tubes 38 from a more or less side view or more or less perpendicularly with respect to the long axis of the test tubes 38.

[0027] In another embodiment at least one test tube 38 may be suspended and held into position by clips, brackets or any other means known to those of ordinary skill in the art. Such an embodiment would not require the test tube housing 40 and opening 30 and would allow the test tubes 38 to be viewed directly through the aperture.

[0028] Fig.3 depicts a cutaway view of the body 14 that provides a view of the electronic architecture of the device 10. According to this embodiment, the body comprises a circuit board 44 in electrical communication with the switch 18. The electronic architecture further comprises a power source 48 in electrical communication 50 with the switch 18 such that when the switch18 is engaged, power flows from the power source 48 to the circuit board 44. The circuit board 44 comprises sockets 45 into which at least one illuminating device 46 may be inserted. The illuminating device 46 may be a light bulb, a light emitting diode, or any other illuminating device familiar to those of ordinary skill in the art. When the circuit board 44 is powered, the at least one illuminating device 46 illuminates the test tubes 38. In the embodiment depicted in Fig.3, the circuit board 44 and the at least one illuminating device 46 are located below the wells 34 such that when the test tubes 38 are suspended into the interior of the test tube housing 40, the at least one illuminating device illuminates the test tube from below the test tube. This results in the viewer viewing the test tubes through the aperture and the opening at a more or less right angle to the direction of the light emitted from the at least one illuminating device 46. The color of the emitted light may be

altered by changing the type of the illuminating device 46. This may be accomplished by replacing the one or more individual illuminating devices 46 in the circuit board. Alternatively, it may be accomplished by unplugging and removing the existing circuit board and replacing it with a circuit board possessing one or more illuminating devices 46 of the desired color. In the alternative, the circuit board could comprise illuminating devices 46 of different colors that are selectable by the user. This may be accomplished, for example by connecting all illuminating devices 46 of one color to an individual circuit within the circuit board and allowing the user to power one or more circuits that activate the illuminating devices that will produce the desired and specific color chemical indication.

[0029] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the window views the test tubes from an angle of 80 degrees or more with respect to the angle of the light.

[0030] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the window views the test tubes from an angle of 70 degrees or more respect to the angle of the light.

[0031] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the

window views the test tubes from an angle of 60 degrees or more with respect to the angle of the light.

[0032] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the window views the test tubes from an angle of 50 degrees or more with respect to the angle of the light.

[0033] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the window views the test tubes from an angle of 40 degrees or more with respect to the angle of the light.

[0034] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the window views the test tubes from an angle of 30 degrees or more with respect to the angle of the light.

[0035] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the window views the test tubes from an angle of 20 degrees or more with respect to the angle of the light.

[0036] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the

window views the test tubes from an angle of 10 degrees or more with respect to the angle of the light.

[0037] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the window views the test tubes from an angle of 5 degrees or more with respect to the angle of the light.

[0038] In an alternative embodiment, the aperture 22 as well as the opening 30 are situated such that the observer, when looking through the window views the test tubes from an angle of 1 degree or more with respect to the angle of the light.

[0039] In another embodiment, depicted in Fig. 4, the device comprises a set of heat blocks 58 located proximal to the test tubes 38, so as to be in thermal communication with the test tubes 38. The heat blocks 58 are in electrical communication with the circuit board 44 such that when the circuit board 44 is powered, the heat blocks 58 are powered. The electrical connection 50 between the heat blocks 58 and the power source 48 may have have at least one resistor 59 or some other device known to those of ordinary skill in the art capable of reducing the current to one or more heat blocks 58 such that the current supplied to the heat block on one side of the test tube is greater than the current supplied to the heat block 58 on the other side of the other side of the test tube. This difference in current causes a temperature differential between the heat

blocks 58 sufficient to create a convection current within the test tube. In the embodiment depicted in Fig. 4, the heat blocks 58 conform more or less to the shape of the test tubes 38 so as to provide a uniform heat transfer between the heat blocks 58 and the test tubes 38.

[0040] In another embodiment, the device 10 comprises a means to adjust the temperatures of the heat blocks. For example, one or more rheostats may be included within the circuitry between the power source and the heat blocks 58 so that the temperature of one or more of the heat blocks 58 may be changed. The temperature may also be controlled by any other device or combination of devices known to those of ordinary skill in the art.

[0041] In another embodiment, the device 10 may have a heating element and/or a cooling element such that the device can be made to thermocycle within a set temperature range.

[0042] In another embodiment, the device does not possess an internal light source, but rather comprises an opening into the interior of the body. This opening may be in the back or in the bottom of the device 10. The open portion is sized and shaped to allow illumination from a light source external the device 10 to enter the device 10 and illuminate the test tubes 38.

[0043] In yet another embodiment, the device possesses a light sensitive meter that registers the wavelength of the light that is emitted from the test tube. The light sensitive meter is in electrical communication with a processor capable of executing a machine readable code that converts the registered wavelength into a digital format. This digitized data may then be stored in memory device that is in electrical communication with the processor. The digitized data may also be displayed in an output device that is in electrical communication with the processor and/or the memory device.

[0044] In another embodiment, the aperture 22 in the shield 20 does not comprise a window 26. In this embodiment, the viewer uses a light filter external to the device to make the indicator visible. For, example, the light filter may comprise glasses with lenses of an appropriate color.

[0045] In another embodiment, the light source is located to the side of the test tubes 38 and the viewing aperture is located above the test tubes 38. In another embodiment, the light source is located to the side of the test tubes 38 and the viewing aperture is located below the test tubes 38. In another embodiment, the light source is located more or less above the test tubes 38 and the viewing aperture 22 is located to the side of the test tubes 38.

[0046] In another embodiment, depicted in Fig. 5, the test tube wells 34 are arranged in at least two rows, staggered. As depicted in Fig. 5, the

test tube wells 34 are arranged in a first row 64 and a second row 60. The test tube wells 34 are arranged in a staggered formation such that the test tubes 38 in the second row 60 are not blocked by the test tubes 38 in the first row 64 from the viewer looking through the aperture.

[0047] In another embodiment, depicted in Fig. 6, windows 68 of varying colors are incorporated into a continuous belt mechanism 70 within the device 10. The belt mechanism 70 is stretched between two rotatable wheels 72. One of the rotatable wheels is affixed to a actuator wheel 76. As the actuator wheel 76 is rotated, it causes the belt mechanism to move, which in turn, causes the windows 68 of varying colors to move between at least one rotatable wheel 72. In this manner, the user may vary the colors of the windows 68 by manipulating the actuator wheel 76 until the window of the desired color appears in front of the aperture 22. As windows 68 of different colors move between the rotatable wheels, they move past the aperture 22 in succession. In addition, Fig 6 depicts a cover 80 attached at the upper portion of the device 10. The cover 80 is configured in such a manner as to block at least a portion of the ambient light.

[0048] In another embodiment, the device10 is too large to be readily hand held.

2013282300 03 Feb 2015

[0049] Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

[0050] The reference to any prior art in this specification is not, and should not be taken as, an acknowledgement or any form of suggestion that the prior art forms part of the common general knowledge in Australia.

CLAIMS

1. An apparatus, comprising:

a controller;

a plurality of heat blocks operatively coupled to the controller;

a housing including:

an aperture;

a means to provide illumination;

a structure to maintain at least one sample container of a plurality of sample containers in a proper position to be viewed through the aperture, wherein the aperture, the means to provide illumination and the structure to maintain at least one sample container is configured such that when at least one sample container is placed in the device, the observer views the at least one sample container at an angle that is more or less perpendicular relative to the direction of the illumination; and

a plurality of wells, each well of the plurality of wells configured to receive a sample container of the plurality of sample containers such that during use, a first side of a first sample container disposed in a first well of the plurality of wells is in proximity of a first heat block of the plurality of heat blocks and a second side of the first sample container is in proximity of a second heat block of the plurality of heat blocks,

the controller configured for, during use, heating the first heat block to a first temperature and the second heat block to a second temperature, the first temperature different than the second temperature, such that a convection current is created between the first side and the second side of the first sample container within a sample disposed in the first sample container.

2. The apparatus of claim 1, the controller configured for heating the first block by applying a first current to the first block and for heating the second block by applying a second current to the second block, the first current different than the second current.

3. The apparatus of claim 1, wherein a first surface of the first heat block conforms substantially to the first side of the first sample container, and a second surface of the second heat block conforms substantially to the second side of the first sample container.

4. The apparatus of claim 1, the controller further configured to thermocycle the first heat block and the second heat block within a predetermined temperature range.

5. The apparatus of claim 1, further comprising a plurality of resistors corresponding to the plurality of heat blocks, each resistor disposed between the controller and its corresponding heat block.

6. The apparatus of claim 5, wherein the plurality of resistors are a plurality of variable resistors.

7. The apparatus of claim 1, the means to provide illumination including a plurality of excitation sources operatively coupled to the controller, each excitation source corresponding to a different well of the plurality of wells, each excitation source configured to, during use, illuminate a corresponding sample container in its corresponding well.

8. The apparatus of claim 1, the aperture including a transparent window formed on a side of the apparatus, the transparent window configured to permit viewing of an interior of the apparatus.

9. The apparatus of claim 8, wherein the transparent window is colored.

10. The apparatus of claim 8, wherein the transparent window is removable.

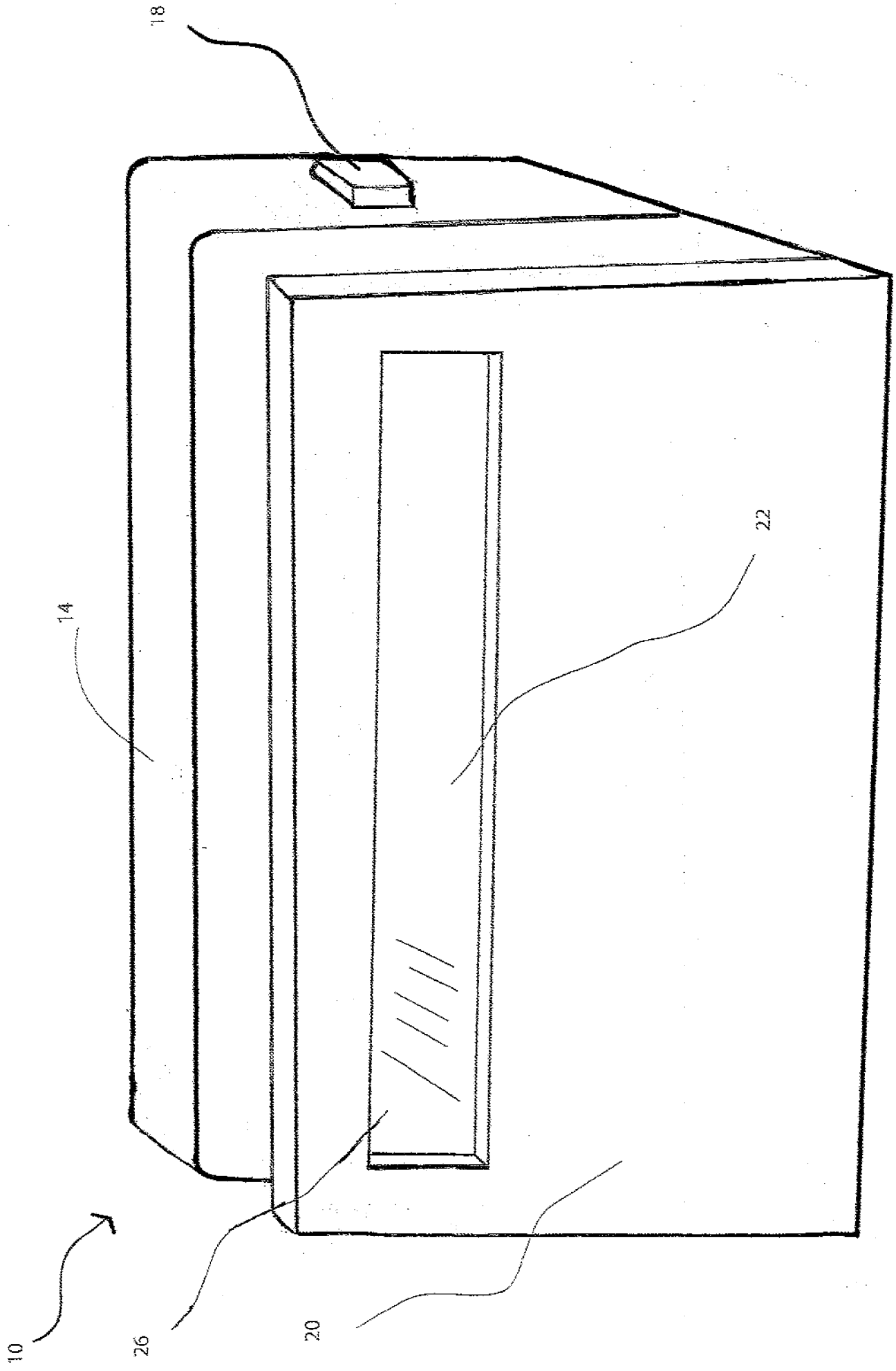

FIG. 1

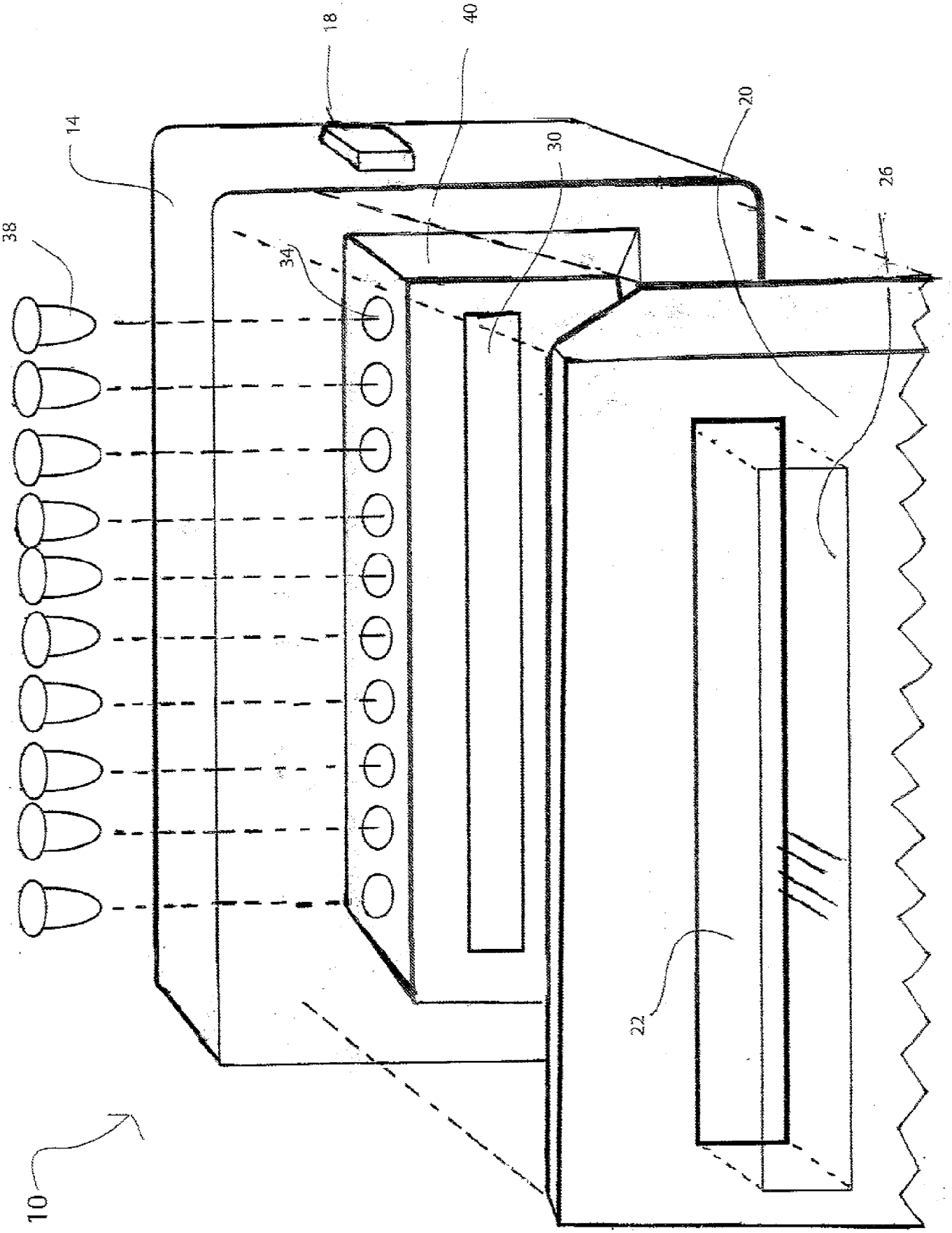

FIG. 2

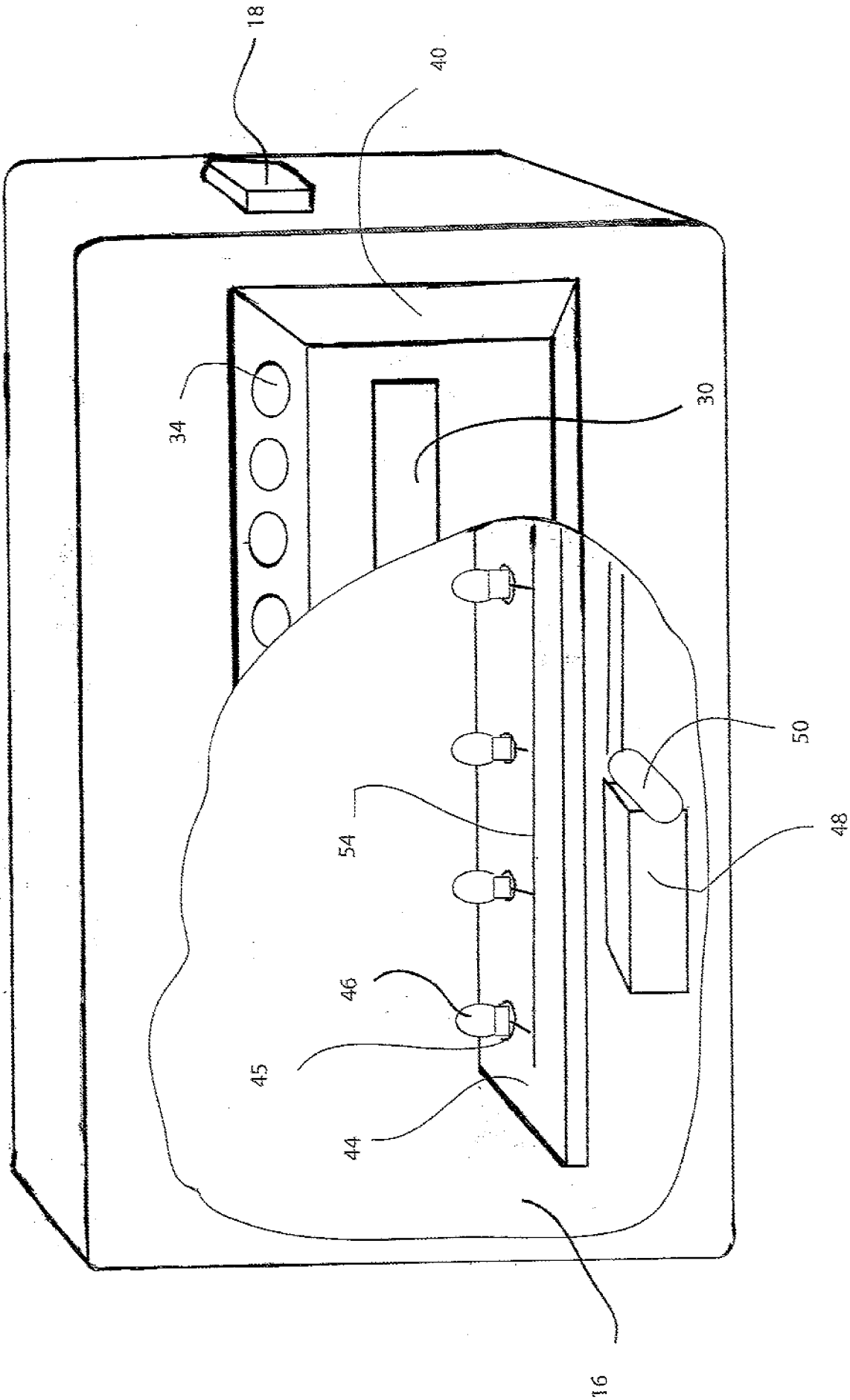

FIG 3

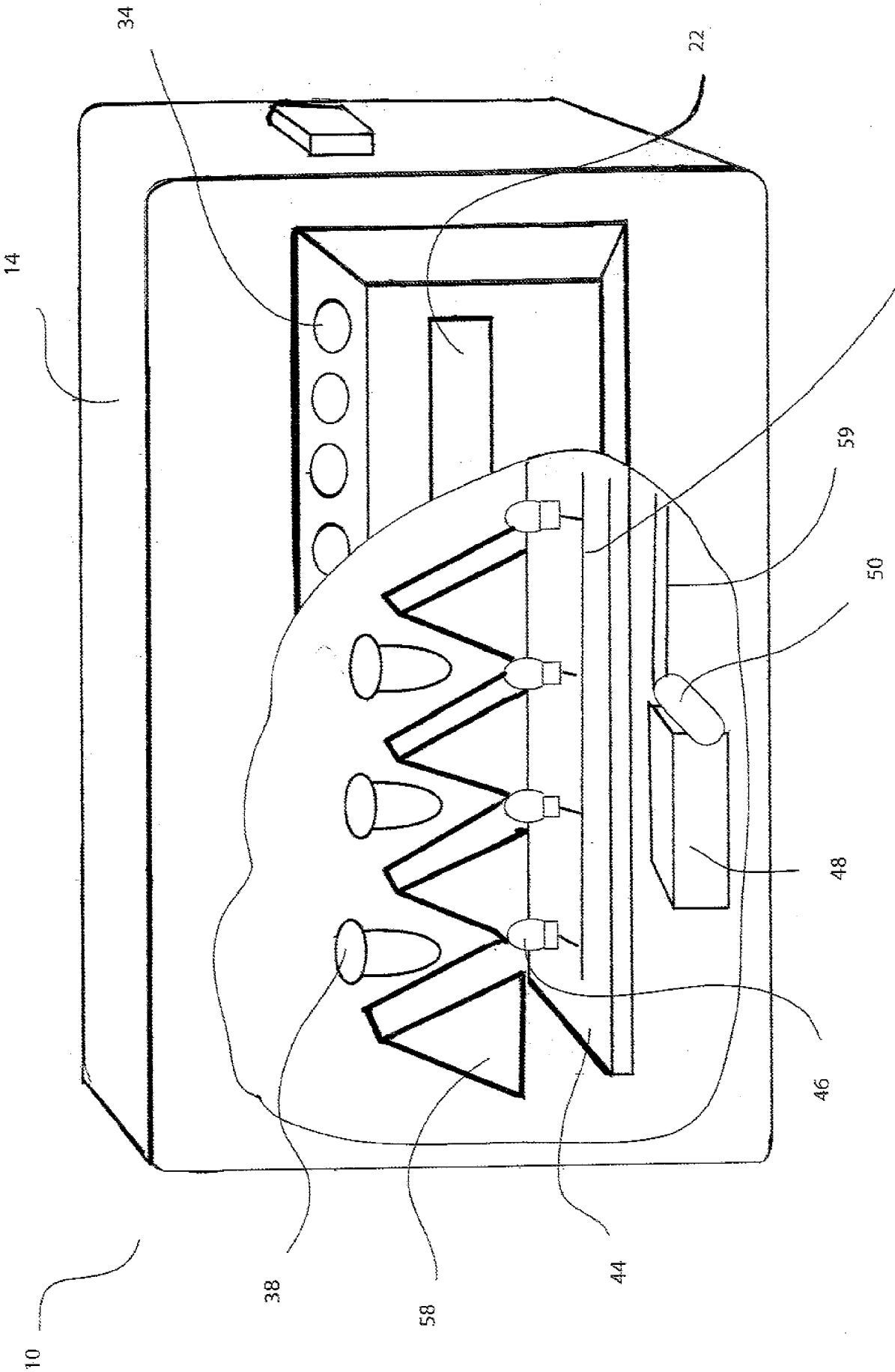

FIG 4

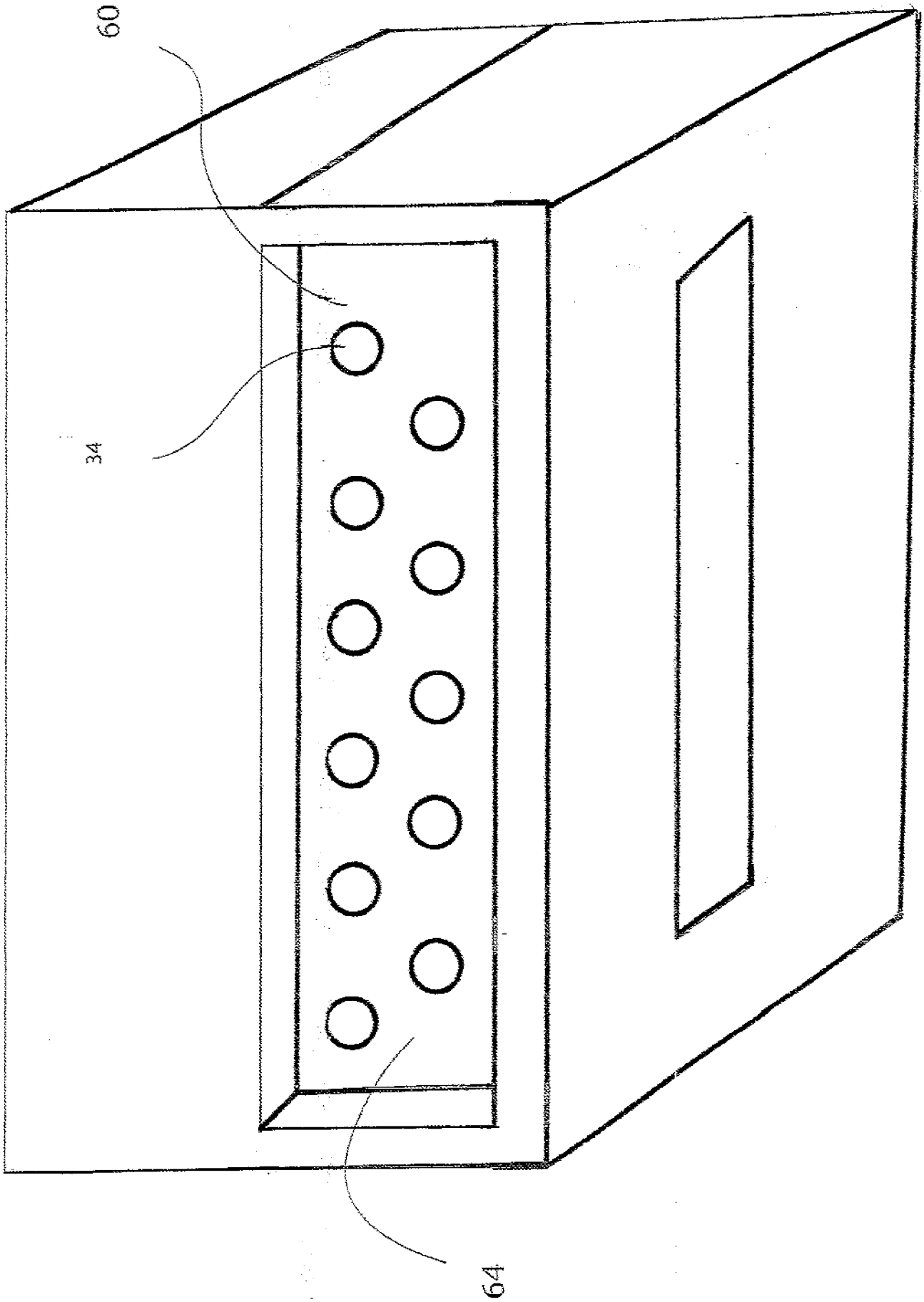

FIG. 5

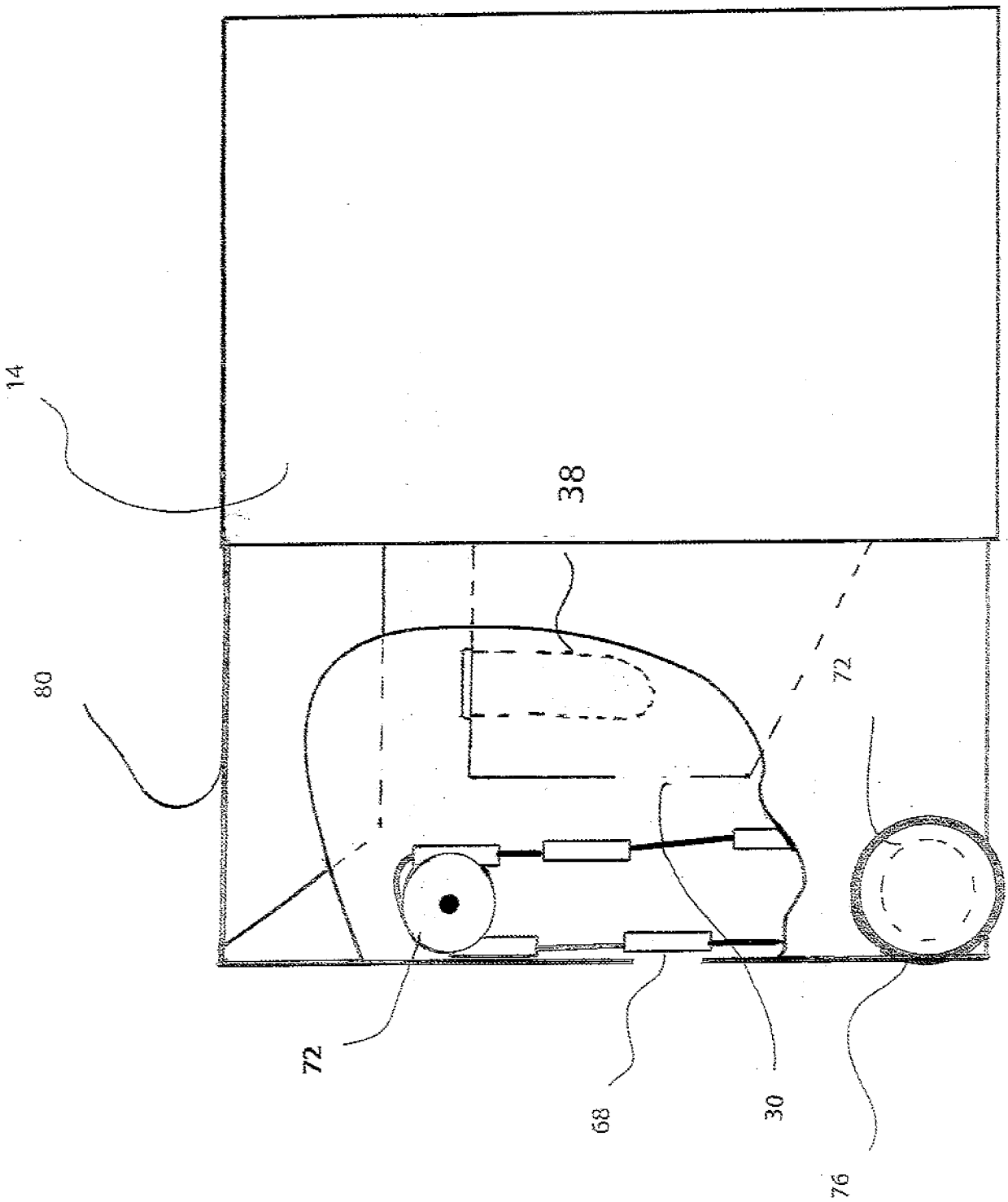

FIG. 6