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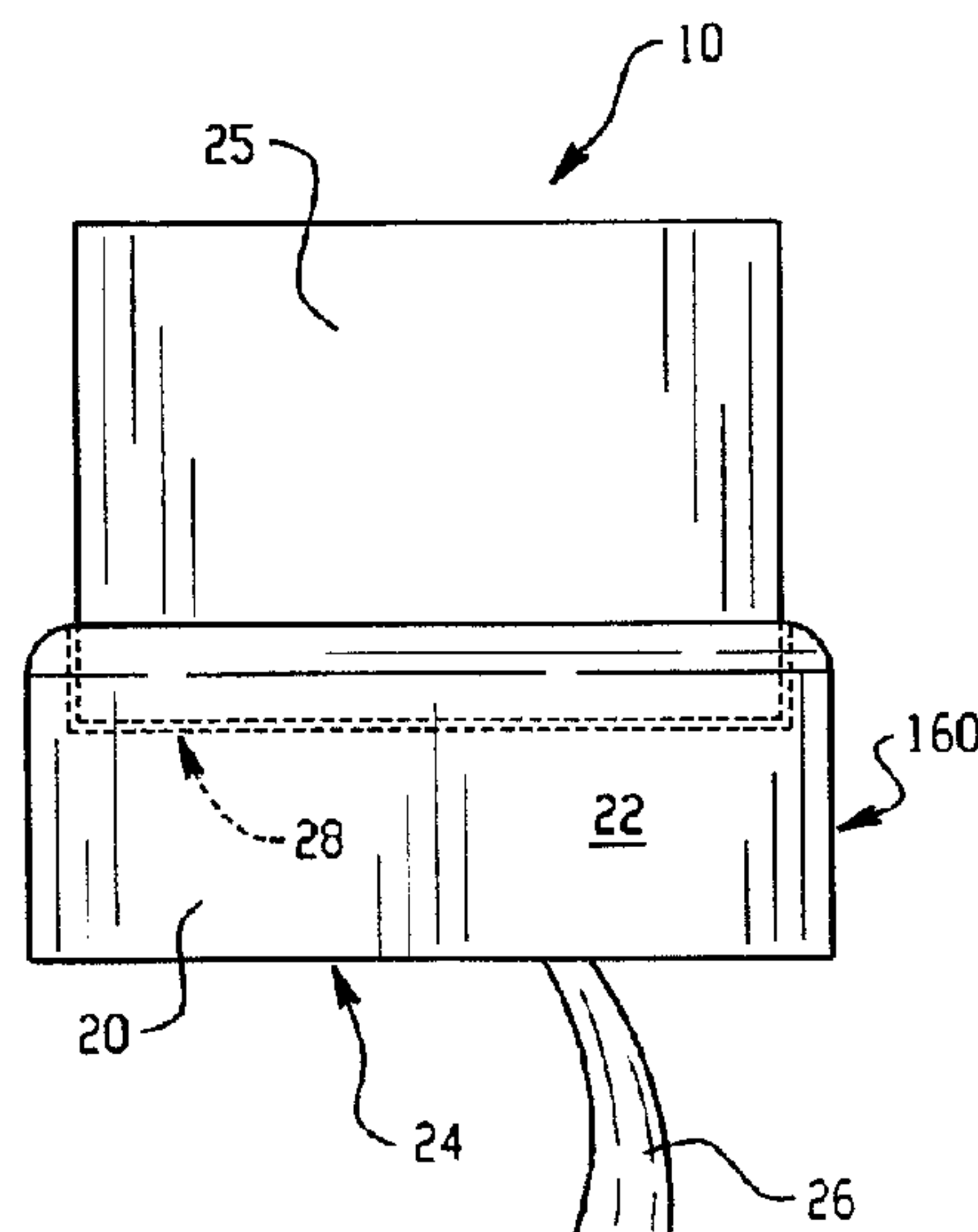
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(54) Titre : UNITE DE DISTRIBUTION DE PRODUIT EN FEUILLE ET CARTOUCHE ASSOCIEE
(54) Title: SHEET PRODUCT DISPENSING UNIT AND A CARTRIDGE THEREFORE



(57) Abrégé/Abstract:

A dispensing apparatus combination includes a sheet product dispensing unit and a cartridge configured to support sheet product, the cartridge being so dimensioned and configured such that it can be located in operable communication with the dispensing unit. The cartridge includes a dispensing opening, and the dispensing unit includes an entry opening and a dispensing opening. The dispensing opening of the cartridge is disposed proximate the entry opening of the dispensing unit when the cartridge is located in operable communication with the dispensing unit such that sheet product is able to pass from the cartridge through the dispensing opening of the cartridge, through the entry opening of the dispensing unit, and through the dispensing opening of the dispensing unit, under a control of the dispensing unit.

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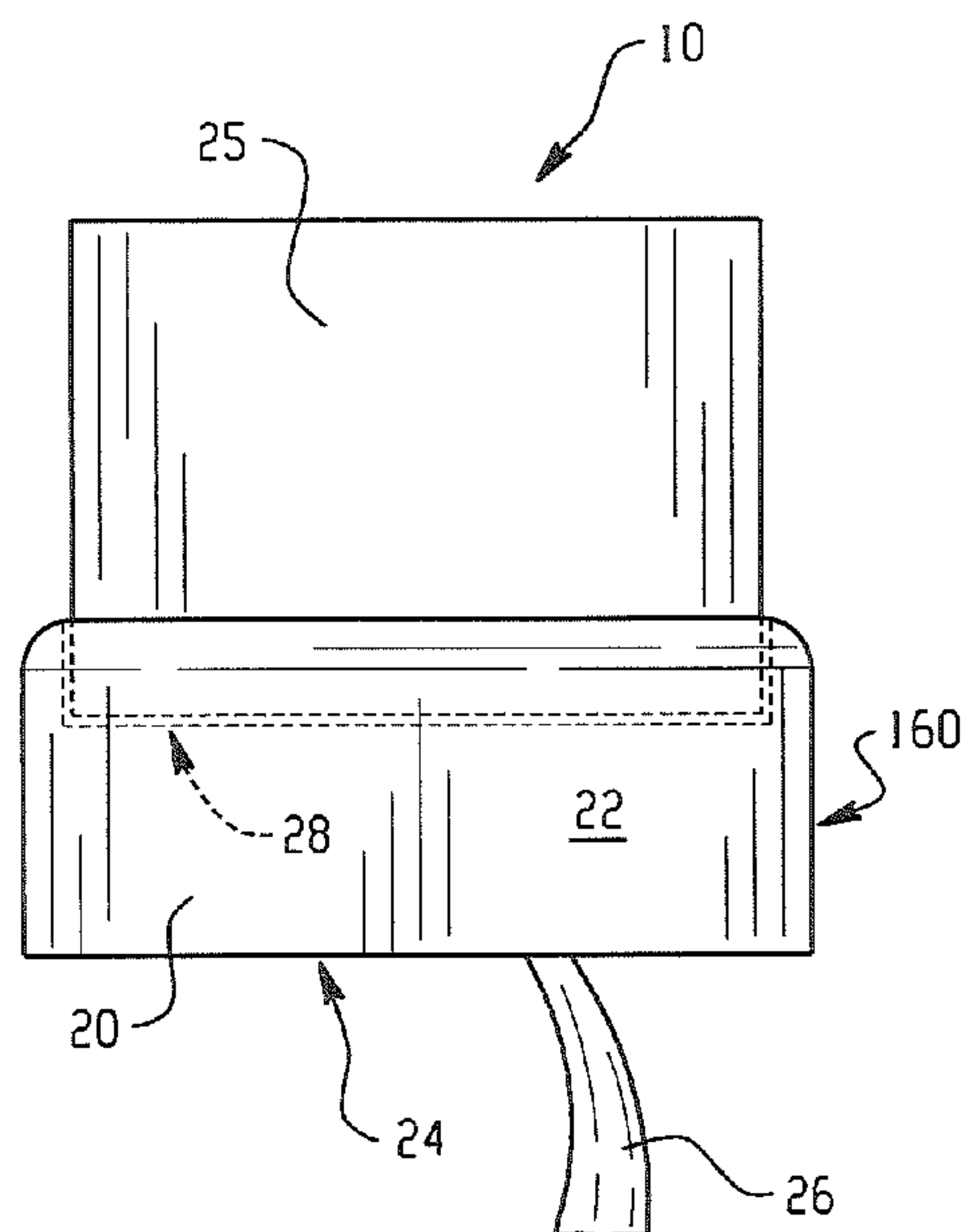


Fig. 1B

(57) Abstract: A dispensing apparatus combination includes a sheet product dispensing unit and a cartridge configured to support sheet product, the cartridge being so dimensioned and configured such that it can be located in operable communication with the dispensing unit. The cartridge includes a dispensing opening, and the dispensing unit includes an entry opening and a dispensing opening. The dispensing opening of the cartridge is disposed proximate the entry opening of the dispensing unit when the cartridge is located in operable communication with the dispensing unit such that sheet product is able to pass from the cartridge through the dispensing opening of the cartridge, through the entry opening of the dispensing unit, and through the dispensing opening of the dispensing unit, under a control of the dispensing unit.

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SHEET PRODUCT DISPENSING UNIT AND A CARTRIDGE THEREFORE

BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to a sheet product dispenser, and more particularly to a combination sheet product dispensing unit and a cartridge therefore, where the cartridge holds the sheet product to be dispensed via the dispensing unit.

[0002] Sheet product dispensers typically include a housing having an interior volume suitably sized for receiving the operational components of the dispenser along with the sheet product to be dispensed, such as paper towel dispensers and toilet paper towel dispensers for commercial applications, for example. Some of these sheet product dispensers are electronically controlled and electrically driven so as to provide touchless, hygienic operation.

[0003] Such dispensers tend to be large, but are well suited for commercial applications where relatively large quantities of sheet product are consumed. However, such dispensers may not be as well suited for other applications requiring hygienic dispensing where limited space is available for the dispensing apparatus. As such, there remains a need in the art for sheet product dispensers that provide hygienic dispensing in areas having limited space.

SUMMARY OF THE INVENTION

[0004] An embodiment of the invention includes a dispensing apparatus combination that includes a sheet product dispensing unit and a cartridge configured to support sheet product, the cartridge being so dimensioned and configured such that it can be located in operable communication with the dispensing unit. The cartridge includes a dispensing opening, and the dispensing unit includes an entry opening and a dispensing opening. The dispensing opening of the cartridge is disposed proximate the entry opening of the dispensing unit when the cartridge is located in operable communication with the dispensing unit such that sheet product is able to pass from the cartridge through the dispensing opening of the cartridge, through the entry opening of the dispensing unit, and through the dispensing opening of the dispensing unit, under a control of the dispensing unit.

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[0005] An embodiment of the invention includes a dispensing apparatus for dispensing sheet product from a cartridge. The dispensing apparatus having a dispensing unit that includes a receiving port so configured and dimensioned as to receive at least a portion of a cartridge configured to support sheet product to be dispensed, an entry opening disposed for receiving sheet product from the cartridge, and a dispensing opening disposed for dispensing sheet product from the dispensing unit. The dispensing unit further includes a drive mechanism and a sensor disposed in signal communication with the drive mechanism, the drive mechanism being responsive to a dispense signal from the sensor to dispense sheet product.

[0006] An embodiment of the invention includes a cartridge for a sheet product dispenser. The cartridge includes an enclosure having a removable section that defines a dispensing opening, and a rejection feature disposed and configured for communicating with a verification feature associated with a sheet product dispenser. Sheet product is disposed within the enclosure in such a manner as to be dispensable through the dispensing opening subsequent to removal of the removable section. The rejection and verification features comprise complementary passive rejection and verification features, complementary active rejection and verification features, or a combination of complementary passive and active rejection and verification features.

[0007] An embodiment of the invention includes a dispensing apparatus combination having an electronic dispensing unit and a separable cartridge. The dispensing unit includes a housing, a motor disposed within the housing, a drive roller in operable communication with the motor, a pinch roller disposed proximate the drive roller, an actuation mechanism disposed in operable communication with the motor to facilitate actuation of the motor, and a dispensing opening disposed proximate the drive roller and the pinch roller, the dispensing unit further comprising a verification feature. The cartridge includes: an enclosure comprising a removable section that defines a dispensing opening, and a rejection feature disposed and configured for communicating with the verification feature of the electronic dispensing unit; and, sheet product disposed within the enclosure in such a manner as to be dispensable through the dispensing opening subsequent to removal of the removable section. The cartridge is so dimensioned and configured as to be engageable with a mating feature of the dispensing unit. The sheet product is configured to be dispensable from the cartridge via

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the dispensing unit through the dispensing opening. At least a portion of the cartridge is disposed outside of the housing of the dispensing unit.

[0008] An embodiment of the invention includes a dispensing apparatus having an electronic dispensing unit and a separable cartridge. The dispensing unit includes a housing, a motor disposed within the housing, a drive roller in operable communication with the motor, a pinch roller disposed proximate the drive roller, an actuation mechanism disposed in operable communication with the motor to facilitate actuation of the motor, and a dispensing opening disposed proximate the drive roller and the pinch roller. The cartridge includes: an enclosure comprising a removable section that defines a dispensing opening; and, sheet product disposed within the enclosure in such a manner as to be dispensable through the dispensing opening subsequent to removal of the removable section. The cartridge is so dimensioned and configured as to be engageable with the dispensing unit. The sheet product is configured to be dispensable from the cartridge via the dispensing unit through the dispensing opening. At least a portion of the cartridge is disposed outside of the housing of the dispensing unit.

[0009] An embodiment of the invention includes a dispensing apparatus for dispensing sheet product from a cartridge. The apparatus includes an electronic dispensing unit having a housing, a motor disposed within the housing, a drive roller in operable communication with the motor, a pinch roller disposed proximate the drive roller, an actuation mechanism disposed in operable communication with the motor to facilitate actuation of the motor, and a dispensing opening disposed proximate the drive roller and the pinch roller. The housing includes a receiving port so configured and dimensioned as to receive at least a portion of the cartridge in which the sheet product is disposed, the drive roller and pinch roller being disposed to dispense the sheet product from the cartridge through the dispensing opening.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Referring now to the drawings, which are meant to be exemplary and not limiting, and wherein like elements are numbered alike:

[0011] Figure 1A is a front perspective view of a top-loaded dispensing apparatus combination in accordance with an embodiment of the invention, the combination including a dispensing unit and a cartridge containing sheet product to be dispensed;

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[0012] Figure 1B is a side perspective view of the dispensing apparatus combination of Figure 1A, with some hidden features depicted in dashed lines;

[0013] Figure 2A is a front perspective view of a top-loaded dispensing apparatus combination alternative to that depicted in Figure 1A;

[0014] Figure 2B is a side perspective view of the dispensing apparatus combination of Figure 2A, with some hidden features depicted in dashed lines;

[0015] Figure 3A is a front isometric view of a front-loaded dispensing apparatus combination alternative to that depicted in Figure 1A;

[0016] Figure 3B is a left side section view of the dispensing apparatus combination of Figure 3A with the cartridge installed;

[0017] Figure 3C is a left side section view of the dispensing apparatus combination of Figure 3A with the cartridge partially installed;

[0018] Figure 4A is a front isometric view of a top-loaded dispensing apparatus combination alternative to that depicted in Figure 1A, including a front display panel;

[0019] Figure 4B is a left side section view of the dispensing apparatus combination of Figure 4A with the cartridge installed;

[0020] Figure 4C another front isometric view of the dispensing apparatus combination of Figure 4A with a messaging insert placed behind the front display panel;

[0021] Figure 5A is a front plan view of a bottom-loaded dispensing apparatus combination alternative to that depicted in Figure 1A, showing section lines for Figure 5B;

[0022] Figure 5B is a left side section view of the dispensing apparatus combination of Figure 5A;

[0023] Figure 6A is a side plan view of a stack of interfolded sheet product with a u-fold configuration;

[0024] Figure 6B is a side plan view of a stack of interfolded sheet product with a z-fold configuration;

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[0025] Figure 7 is a schematic view illustration of dispensing unit components of the dispensing apparatus combination of any one of Figures 1A, 2A, 3A, 4A and 5A;

[0026] Figure 8 is a logic flow block diagram illustration of the dispensing apparatus combination of any one of Figures 1A, 2A, 3A, 4A and 5A;

[0027] Figure 9 is a front-left-side perspective view of a portion of a dispensing unit in accordance with an embodiment of the invention;

[0028] Figure 10 is a front-right-side perspective view of the dispensing unit portion of Figure 9;

[0029] Figure 11 is a schematic illustration of the field of view for a proximity sensor showing an area of high probability for triggering the proximity sensor, in accordance with an embodiment of the invention;

[0030] Figure 12 is an exploded assembly view of a drive motor assembly, in accordance with an embodiment of the invention;

[0031] Figure 13 is a bottom-left-side perspective view of a cartridge, for a top-loaded arrangement, in accordance with an embodiment of the invention;

[0032] Figure 14 is a similar view to that of Figure 13 with an end panel of the cartridge enclosure not shown to show a stack of u-folded sheet product disposed therein;

[0033] Figure 15 is a similar view to that of Figure 13 with an end panel of the cartridge enclosure not shown to show a roll of sheet product disposed therein, and showing section lines for Figures 16 and 17;

[0034] Figure 16 is a section view of Figure 15 illustrating inwardly extending protrusions of a first type for pivotally supporting the roll of sheet product;

[0035] Figure 17 is an alternative section view to that of Figure 16 illustrating inwardly extending protrusions of a second type for pivotally supporting the roll of sheet product, and showing viewing lines for Figure 18;

[0036] Figure 18 is a partial side plan view illustrating the cut lines and score lines in the enclosure of the cartridge for forming the pivotal supports depicted in Figure 17;

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[0037] Figure 19 is a front plan view of a cartridge having deformable sections disposed in a first position, in accordance with an embodiment of the invention;

[0038] Figure 20 is a front plan view of the cartridge of Figure 19 having the deformable sections disposed in a second position, in accordance with an embodiment of the invention;

[0039] Figure 21 is a partial top-down perspective view of a dispensing unit, a cartridge, and rejection/verification features, in accordance with an embodiment of the invention;

[0040] Figure 22 is a partial top-down perspective view of a dispensing unit, a cartridge, and alternative rejection/verification features, in accordance with an embodiment of the invention;

[0041] Figure 23 is a partial top-down perspective view of a dispensing unit, a cartridge, and further alternative rejection/verification features, in accordance with an embodiment of the invention;

[0042] Figure 24A is a partial block diagram schematic of a dispensing unit, a “to be installed” cartridge, and a non-actuated enable switch, in accordance with an embodiment of the invention; and

[0043] Figure 24B is a partial block diagram schematic of the dispensing unit, the cartridge, and the enable switch of Figure 24A, with the cartridge installed and the enable switch actuated.

DETAILED DESCRIPTION

[0044] An embodiment of the invention is directed generally to a reusable automatic paper towel dispensing apparatus that utilizes a disposable cartridge configured to support paper towels to be dispensed. The dispensing apparatus includes a dispensing unit that includes an entry opening for receiving paper towels from the disposable cartridge, and a dispensing opening for dispensing the paper towels to a user. The disposable cartridge includes a dispensing opening to facilitate transfer of the paper towels from the cartridge to the dispensing unit via the entry opening of the dispensing unit. When the cartridge is operably associated with the dispensing unit, the dispensing opening of the cartridge is

disposed in operable communication with the entry opening of the dispensing unit so that a paper towel can travel from the cartridge into the dispensing unit. Once the cartridge is empty of paper towels, the cartridge can be separated from the dispensing unit and substituted with a replacement cartridge. The empty cartridge can be disposed thereafter.

[0045] Figures 1A, 1B, 2A, 2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A and 5B illustrate alternative embodiments of a dispensing apparatus 10 that includes in combination an electronic dispensing unit 20 and a separable cartridge 25 configured to support sheet product 26 that is dispensable through a dispensing opening 32 of the dispensing unit 20. Figures 1A and B, and Figures 2A and B, depict similar top-load cartridge arrangements, where Figures 1A and B are illustrative of a more slimline design. Figures 3A, B and C, depict a front-load cartridge arrangement. Figure 3A also depicts the cartridge 25 having a window 30 strategically disposed, such as on a visible front surface of the cartridge 25 for example, so that the remaining amount of sheet product 26 associated with the cartridge is visible to a user. In an embodiment, the window 30 is covered with a suitable material to permit viewing therethrough, such as a clear plastic film for example, while keeping the sheet product within the cartridge clean. Figures 4A, B and C, depict an alternative top-load cartridge arrangement having an integrally arranged front display panel 150 suitable for holding messages 155 between the panel 150 and a front cover 22 of the dispensing unit 20. In an embodiment, the front display panel 150 is a clear panel that allows for customized messages, such as: general hand washing tips, preventative measures to the spread of Flu virus, notification that “Employees Must Wash Hands”, and the like. Figures 5A and B, depict a bottom-load arrangement, suitable for placement under a cabinet hanging on a wall above a countertop, for example. With consideration to the foregoing illustrations, embodiments of the invention include arrangements where the cartridge 25 is engageable with the dispensing unit 20 at the top, the bottom, or the front of the dispensing unit 20, where each of the cartridges 25 in each arrangement fit securely with the dispensing unit 20, which may include fitting the cartridge 25 into a cavity 28 of the dispensing unit 20, for example, or may include fitting the cartridge 25 with the dispensing unit 20 via brackets, posts, or any other means suitable for a purpose disclosed herein.

[0046] As can be seen from Figures 1A, 1B, 2A, 2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A and 5B, at least a portion of the cartridge 25 is disposed outside of the dispensing unit 20.

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[0047] As can be seen from Figures 1A, 2A, 3A, 4A and 5A, the dispensing unit 20 is not limited to the height of the cartridge 25 that it receives, it is only limited to the length and depth of the cartridge that fits into the cavity 28. Thus, dispensing unit 20 can receive cartridges of different sizes, where the length and depth of the cartridges remain constant, but the height varies to provide for different quantities of sheet product 26, standard and super-sized for example.

[0048] In an embodiment, the dispensing unit 20 is attachable to a support structure, such as a wall for example, using any hardware suitable for the purposes, or using a no-drill, pull-and-stick adhesive strip, for example. In another embodiment, the dispensing unit 20 is attachable to a steel panel (or a panel made from any ferromagnetic material) using a permanent magnet securely attached to the engaging surface of the dispensing unit 20.

[0049] The term "sheet product" as used herein is inclusive of natural and/or synthetic cloth or paper sheets. Sheet product may include both woven and non-woven articles. There are a wide variety of nonwoven processes, and they can be either wetlaid or drylaid. Some examples include hydroentagled (sometimes called spunlace), DRC (double re-creped), airlaid, spunbond, carded, paper towel, and meltblown sheet products. Further, sheet product may contain fibrous cellulosic materials that may be derived from natural sources, such as wood pulp fibers, as well as other fibrous material characterized by having hydroxyl groups attached to the polymer backbone. These include glass fibers and synthetic fibers modified with hydroxyl groups. Examples of sheet product include, but are not limited to, wipers, napkins, tissues, rolls, towels or other fibrous, film, polymer, or filamentary products.

[0050] In general sheet products are thin in comparison to their length and breadth and exhibit a relatively flat planar configuration and are flexible to permit folding, rolling, stacking, and the like. In an embodiment, the sheet product 26 is in the form of a roll and may have perforations extending in lines across its width to separate individual sheets and facilitate separation or tearing of individual sheets from the roll at discrete intervals. Individual sheets may be sized as desired to accommodate the many uses of the sheet products. For example, perforation lines may be formed every 13 inches to define a universally sized sheet. Multiple perforation lines may be provided to allow the user to select the size of sheet depending on the particular need. In an alternative embodiment, the sheet product 26 is in the form of a plurality of discrete sheets that are stacked in such a manner relative to one another so as to be dispensable through the dispensing opening 32 of the

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dispensing unit 20 one after the other in succession. The stacked plurality of discrete sheets may be non-interfolded sheets, or may be interfolded u-fold sheets or a u-folded bundle, interfolded z-fold sheets or a z-folded bundle, or arranged in any other engaging relationship that provides for one at a time dispensing one after the other in succession (best seen by referring to Figures 6A and 6B, respectively). In an embodiment where the sheet product 26 is interfolded, it may be fully interfolded, or offset and not fully interfolded. As used herein, the term “fully interfolded” means that the end of a first sheet is disposed substantially adjacent to the inner fold of an adjacent next-in-line interfolded sheet (as seen in Figures 6A and 6B for example), and the term “offset and not fully interfolded” means that the end of a first sheet is not disposed substantially adjacent to the inner fold of an adjacent next-in-line interfolded sheet but instead has a gap therebetween, which is contemplated to reduce frictional drag to ease with sheet product dispensing.

[0051] While embodiments are disclosed herein utilizing a sheet product being inclusive of natural and/or synthetic cloth or paper sheets, it will be appreciated that the scope of the invention is not so limited, and that the invention also encompasses other sheet materials, such as aluminum foil and plastic wrap for example, where the plastic wrap includes, but is not limited to, such materials as, low density polyethylene (LDPE), and polyvinylidene chloride (PVdC), for example.

[0052] In an embodiment, and with reference generally to Figures 1-5, 7 and 15, an embodiment of the dispensing unit 20 includes a cavity 28 (alternatively herein referred to as a receiving port) that provides room for receiving or nesting the cartridge 25 therein, and a front cover 22 that is disposed on and supported by a back plate 24. When a cartridge 25 is operably associated with a dispensing unit 20, sheet product 26 from the cartridge 25 is operably disposed so that it can pass out through a dispensing opening 21 of the cartridge 25 and into an entry opening 23 of the dispensing unit 20, ready for dispensing out of the dispensing opening 32 of the dispensing unit 20 for use by a user. In an embodiment, drive and pinch rollers 126, 124 associated with a dispensing mechanism 40 of the dispensing unit 20 are disposed in close enough proximity to the entry opening 23 of the dispensing unit 20 so that sheet product 26 from the cartridge 25 is easily received by a nip 125 formed between the drive and pinch rollers 126, 124 during installation of a cartridge 25 into a dispensing unit 20. In an embodiment, a user positions the lead edge of a first sheet of sheet product 26 into the entry opening 23 of the dispensing unit 20 so that it is easily captivated by the nip 125

ready for dispensing. In an embodiment, the front cover 22 is formed from any suitable material, such as a plastic, that is cost effective and suitable for a purpose disclosed herein. In an embodiment, the front cover 22 is opaque, translucent or tinted. If the front cover 22 is translucent, it may provide advantages in allowing maintenance personnel and/or users to quickly determine the quantity of sheet product 26 remaining in a cartridge 25 having a window 30.

[0053] In an embodiment, the dispensing unit 20 includes one or more light-emitting-diodes (LEDs) 34 to provide a visual indication as to the status of the dispensing unit. An embodiment may also include an actuation mechanism in the form of a proximity sensor 36 positioned proximate the front cover 22 near the dispensing opening 32 to facilitate dispensing of the sheet product 26 in a touchless manner. In another embodiment, the actuation mechanism may be provided in the form of a manual pushbutton 37, or a tear bar sensor 57. In an embodiment employing a proximity sensor 36, the proximity sensor 36 may be an infrared sensor, a capacitive sensor, or any other sensor suitable for a purpose disclosed herein that is capable of sensing the presence of a user's hand in front of the dispensing unit 20 and sending a dispense-demand signal to a dispensing mechanism (to be discussed further below). In an embodiment employing a manual pushbutton 37 used in place of a touchless proximity sensor 36, the manual pushbutton 37 provides a dispense-demand signal to the dispensing mechanism 40 via a main controller 38 in a manner similar to that of the proximity sensor 36. In an embodiment employing a tear bar sensor 57, which is configured and disposed to sense a dispensing action via movement of a tear bar 75 in a tear bar assembly 76, a next in line sheet product to be dispensed is automatically advanced in a "hang mode" fashion, which is discussed further below. Accordingly, reference herein to a proximity sensor 36 is also intended to encompass dispensing via a manual pushbutton, a touch-button, or the like, or a tear bar sensor used in conjunction with hang mode dispensing.

[0054] An example schematic representation of operable components of the dispensing unit 20 is shown in Figure 7. It should be appreciated that the illustration in Figure 7 is for purposes of description and that the relative size and placement of the respective components may differ. The dispensing unit 20 includes a main controller 38. As will be described in more detail herein, the main controller 38 provides logic and control functionality used during operation of the dispensing unit 20. Alternatively, the functionality of the main controller 38 may be distributed to several controllers that each provides a

portion of the functionality of a main controller to discrete portions of the operation of dispensing unit 20. In an embodiment, the main controller 38 is coupled to a dispensing mechanism 40 to dispense a sheet product 26 when activated by a user when the dispensing apparatus 10 is operating in “on demand mode”, or when activated by a tear bar sensor when the dispensing apparatus 10 is operating in “hang mode”. A motor 42 and an optional transmission assembly 44 drives the dispensing mechanism 40. In an embodiment, the combination of the motor 42, optional transmission assembly 44, and dispensing mechanism 40, is alternatively referred to as a drive mechanism 39. The optional transmission assembly 44, such as a gearbox for example, adapts the rotational output of the motor 42, which is operably coupled to the proximity sensor 36, manual pushbutton 37, or tear bar sensor 57, via the main controller 38, for the dispensing of the sheet product 26.

[0055] In an embodiment, the electrical energy for operating the dispensing unit 20 is provided by a battery 46, which may be comprised of one or more batteries arranged in series or in parallel to provide the desired energy. In an embodiment, the battery 46 includes four 1.5-volt “D” cell batteries. The battery 46 is connected to the main controller 38 via an optional power converter 48 that adapts the electrical output of the battery 46 to that desired for operating the dispensing unit 20. The optional power converter 48 may also accept an input from an external power source 50, such as an alternating current (“AC”) power source or a solar power source, or any other alternative power source as may be appropriate for a particular application. The AC power source 50 may be any conventional power source, such as a 120V, 60 Hz wall outlet for example.

[0056] The main controller 38 is a suitable electronic device capable of accepting data and instructions, executing the instructions to process the data, and presenting the results. As suggested above, the main controller 38 may accept instructions through a user interface, or through other means such as but not limited to a proximity sensor, a manual pushbutton, a tear bar sensor, voice activation means, manually-operable selection and control means, radiated wavelength and electronic or electrical transfer, for example. Therefore, main controller 38 can be, but is not limited to a microprocessor, microcomputer, a minicomputer, an optical computer, a board computer, a complex instruction set computer, an ASIC (application specific integrated circuit), a reduced instruction set computer, an analog computer, a digital computer, a molecular computer, a quantum computer, a cellular computer, a solid-state computer, a single-board computer, a buffered computer, a computer

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network, a desktop computer, a laptop computer, a personal digital assistant (PDA) or a hybrid of any of the foregoing.

[0057] Main controller 38 is capable of converting the analog voltage or current level provided by sensors, such as proximity sensor 36 for example, into a digital signal indicative of a user placing their hand in front of the dispensing unit 20. Alternatively, proximity sensor 36 may be configured to provide a digital signal to main controller 38, or an analog-to-digital (A/D) converter 52 maybe coupled between proximity sensor 36 and main controller 38 to convert the analog signal provided by proximity sensor 36 into a digital signal for processing by main controller 38. Main controller 38 uses the digital signals as input to various processes for controlling the dispensing unit 20. The digital signals represent one or more dispensing unit data including but not limited to proximity sensor activation, manual pushbutton activation, verification feature activation, enable switch activation, cartridge empty notification, motor current, motor back electromotive force, or battery level, for example. It should be appreciated that in some embodiments, the main controller 38 may be arranged to also include one or more direct analog inputs to receive one or more analog signals instead of or in addition to digital signals.

[0058] Main controller 38 is operably coupled with one or more operational components of dispensing unit 20 by data transmission media 54. Data transmission media 54 includes, but is not limited to, solid-core wiring, twisted pair wiring, coaxial cable, and fiber optic cable. Data transmission media 54 also includes, but is not limited to, wireless, radio and infrared signal transmission systems. Main controller 38 is configured to provide operating signals to the operational components and to receive data from the operational components via data transmission media 54. Main controller 38 communicates over the data transmission media 54 using a computer communications protocol such as Inter-Integrated Circuit (I2C), Serial Peripheral Interface (SPI), System Management Bus (SMBus), Transmission Control Protocol/Internet Protocol (TCP/IP), RS-232, RS-485, ModBus, or any other communications protocol suitable for a purpose disclosed herein.

[0059] As will be described in more detail herein, main controller 38 accepts data from sensors and other devices, such as a proximity sensor 36, a manual pushbutton 37, a sheet product sensor 56, a tear bar sensor 57, a verification feature 305, and an enable switch 320, for example, and provides operational control signals to devices such as LED's 34, and motor 42 for example. Main controller 38 is also given certain instructions from an

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executable instruction set for the purpose of comparing the data from sheet product sensor the aforementioned sensors and devices to predetermined operational parameters. Main controller 38 provides operational control signals to motor 42 that activates a dispensing action of sheet product 26.

[0060] In an embodiment, main controller 38 includes a processor 62 coupled to a random access memory (RAM) device 64, a non-volatile memory (NVM) device 66, and a read-only memory (ROM) device 68. Main controller 38 may optionally be connected to one or more input/output (I/O) controllers or data interface devices (not shown). NVM device 66 is any form of non-volatile memory such as an EPROM (Erasable Programmable Read Only Memory) chip, an EEROM (Electrically Erasable Read Only Memory), a flash memory chip, a disk drive, or the like. Stored in NVM device 66 are various operational parameters for the application code. It should be recognized that application code could be stored in NVM device 66 rather than ROM device 68.

[0061] Main controller 38 includes operation control methods embodied in application code. These methods are embodied in computer instructions written to be executed by processor 62, typically in the form of software. The software can be encoded in any language, including, but not limited to, machine language, assembly language, VHDL (Verilog Hardware Description Language), VHSIC HDL (Very High Speed IC Hardware Description Language), Fortran (formula translation), C, C++, Visual C++, Java, ALGOL (algorithmic language), BASIC (beginners all-purpose symbolic instruction code), visual BASIC, ActiveX, HTML (HyperText Markup Language), and any combination or derivative of at least one of the foregoing. Additionally, an operator can use an existing software application such as a spreadsheet or database and correlate various cells with the variables enumerated in the algorithms. Furthermore, the software can be independent of other software or dependent upon other software, such as in the form of integrated software.

[0062] As previously discussed, an embodiment of the dispensing mechanism 40 is configured and arranged to receive sheet product 26 from cartridge 25. A user of dispensing apparatus 10 manually fills/refills the dispensing unit 20 with a cartridge 25 containing sheet product 26, extracts a leading end of the sheet product 26 through the dispensing opening 21 of the cartridge 25 and positions the leading end of sheet product 26 within the entry opening 23 within the cavity 28 of the dispensing unit 20 and towards a roller assembly 74 that includes a pair of rollers, a drive roller 126 and a pinch roller 124, that pull the sheet product

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when activated by motor 42. In an embodiment, the leading edge of sheet product 26 includes a leader tab 19 to facilitate manual feeding of a new sheet product in a new cartridge between drive roller 126 and pinch roller 124. In an embodiment, a tear bar assembly 76 is positioned adjacent the dispensing opening 32 to provide a means for separating the dispensed sheet product 26 from a roll of sheet product when the sheet product is in the form of a roll. In an embodiment employing an interfolded sheet product 26, the drive roller 126 and pinch roller 124 may be biased toward each other in such a manner as to deter the interfold of the sheet product from dispensing the next-in-line sheet. Such biasing may be achieved by a spring, for example (not shown).

[0063] A sheet product sensor 56 is positioned adjacent to the roller assembly 74. As will be described in more detail herein, the sheet product sensor 56 provides a signal to the main controller 38 that indicates whether sheet product is still being dispensed from cartridge 25. The arrangement of providing a sheet product sensor 56 to monitor the dispensing of sheet product 26 provides advantages in that it enables the dispensing unit 20 to use all, or almost all of the sheet product in cartridge 25 before signaling to a user that the cartridge 25 is empty and needs replacing. It should be appreciated that while the sheet product sensor 56 may be described herein as being positioned on the in-feed side of the rollers in roller assembly 74, the sheet product sensor 56 may alternatively be positioned on the out-feed side of the rollers as well.

[0064] In an embodiment, the sheet product sensor 56 may also be used by main controller 38 to control the amount of sheet product 26 being dispensed, especially when the sheet product 26 is in the form of a roll. That is, sheet product sensor 56 can be utilized to provide “length-of-sheet-dispensed” information in real time to main controller 38, thereby enabling main controller 38 to stop the dispensing cycle as desired. In an embodiment, the length of sheet dispensed is adjustable via an adjustment switch (not shown but conveniently placed on the dispensing unit 20 and in signal communication with the main controller 38). While an embodiment is discussed herein employing a sheet product sensor 56 for dispensing a controlled length of sheet product 26, it will be appreciated that other control means may be employed for accomplishing a same result, such as for example, using the main controller 38 to control the run-time of the motor 42, using a “hold time” of the manual pushbutton 37 to interpret a long hold time as a demand for a longer length of sheet product, or using the

verification feature to determine an appropriate length of sheet product to dispense depending upon the type of sheet product associated with the cartridge 25.

[0065] In an embodiment where the sheet product 26 is provided in the form of a roll, and after the roller assembly 74 pulls the sheet product from the cartridge 25, the sheet product 26 proceeds to tear bar assembly 76, which is positioned adjacent the dispensing opening 32. A means for cutting the sheet product 26 is included in tear bar assembly 76 once the appropriate amount of sheet product 26 has been dispensed. Typically, this is accomplished using a serrated edge tear bar 75 that cuts into the sheet when the user pulls the dispensed sheet product 26. The portion of the sheet product 26 separated from the roll may then be used and discarded as necessary by the user.

[0066] In an embodiment where the sheet product 26 is provided in the form of a plurality of discrete sheets interfolded together or otherwise arranged to dispense one after the other in succession (see Figures 6A and 6B, for example), it is not necessary for dispensing mechanism 40 of dispensing unit 20 to have a tear bar assembly 76. In such an embodiment, and after the roller assembly 74 pulls the next-to-be-dispensed sheet product from the cartridge 25, main controller 38 stops motor 42 after the dispensing action is complete, thereby leaving the leading edge of the next-in-line sheet of sheet product 26 between the rollers 124, 126 of roller assembly 74 for a next dispensing action. In an embodiment operating in a “hang mode”, the leading edge of the next-in-line sheet of sheet product 26 is left protruding through the dispensing opening 32, which provides the user with a visual indication that sheet product is available for use. In another embodiment operating in a “hang mode”, an entire sheet of the next-in-line sheet of sheet product 26 is presented at the dispensing opening 32. When operating in an “on demand mode”, the leading edge of the next-in-line sheet of sheet product 26 is typically hidden from view, which provides the user with some assurance that the next-in-line sheet product is untouched and ready for use.

[0067] While Figures 6A and 6B depict alternative arrangements of a plurality of discrete sheets interfolded together, and other embodiments are described herein utilizing a roll of sheet product, it will be appreciated that any other arrangement of sheet product suitable for dispensing from the cartridge 25 via the dispensing unit 20 may also be employed, and is considered within the scope of the invention. Such an alternative arrangement of sheet product may include, but is not limited to, a continuous z-fold of sheet product, for example. In an embodiment utilizing a roll of sheet product or a continuous z-

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fold of sheet product, a tear bar assembly 76 may be included to facilitate separation of individual sheets. In an embodiment utilizing a plurality of discrete sheets interfolded together, the tear bar assembly 76 may be omitted.

[0068] The operation of the dispensing unit 20 may be thought of as a series of dispensing cycles 78 as shown in Figure 8. Upon receipt of a dispense request from one of the aforementioned sensors or control devices (time = t0), a signal is transmitted from the respective sensor or control device to the main controller 38 (time = t1). The main controller 38 executes instructions in response to the signal and executes one or more routines to activate the motor 42 (time = t2). The motor 42 in turn rotates one of the rollers in roller assembly 74 (time = t3). The rotation of the roller causes the sheet product 26 to be pulled from the cartridge 25 until the desired amount of sheet product 26 has been dispensed 79 from the dispensing unit 20 (time = t3). As discussed above, sheet product sensor 56, or any other device disclosed herein for controlling the sheet dispense length, may be utilized to control the amount of sheet product 26 dispensed. When the sheet product 26 is provided in the form of a roll, the sheet product 26 is separated from the roll of sheet product via tear bar assembly 76.

[0069] During the dispensing cycle, it is possible that the sheet product 26 contained in the cartridge 25 will be expended or otherwise depleted. As discussed above, a sheet product sensor 56 may be arranged to detect the presence of the sheet product 26, and may be disposed at either the in-feed or out-feed portion of the roller assembly 74. Once the sheet product 26 from cartridge 25 is not detected by the sheet product sensor 56, the main controller 38 activates one of LEDs 34 to signal an empty cartridge 25, and the dispensing unit 20 enters into a hold-mode until a new cartridge 25 is placed in the receiving cavity 28 of dispensing unit 20. In view of some embodiments of the dispensing unit 20 disclosed herein having other sensors and/or switches, such as a verification feature 305 or an enable switch 320, for example, it will be appreciated that LED's 34 could be utilized and activated to signal other conditions, such as insertion of a non-authorized product that would result in a product-verification-failure-signal from the verification feature 305, or an absence of a cartridge 25 in cavity 28 that would result in a product-absent-signal from the enable switch 320, for example. Additionally, it is contemplated that the sheet product sensor 56 could also be used to sense a misfed or jammed sheet product, in which case the sheet product sensor 56

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would provide a signal to the main controller 38 to facilitate activation of more than one LED 34, or one LED 34 in a pulsed manner.

[0070] A portion 27 of an example dispensing unit 20 is shown in Figures 9-11. In the illustrated embodiment of Figures 9-11, the dispensing unit portion 27 includes a chassis 82 that is configured to couple to the backplate 24, and is configured to be covered by the front cover 22. In an embodiment, the combination of the backplate 24, front cover 22, and chassis 82 define a housing 160 of the dispensing unit 20. However, and notwithstanding the foregoing description, it is also considered within the scope of the invention to consider the cartridge 25 as being part of the housing 160, which for purposes of discussion herein is described as the dispensing apparatus 10. The chassis 82 supports the roller assembly 74, which is positioned within the chassis 82 between the proximity sensor 36 and a battery housing 92. The battery housing 92 is configured to hold batteries 46, such as but not limited to D-cell batteries for example. As discussed above, the roller assembly 74 delivers the sheet product 26 from the cartridge 25 to the dispensing opening 32 to make the sheet product 26 available to the user. The dispensing unit portion 27 also includes a drive motor assembly 45, which includes motor 42 (hidden from view in Figure 9) that is coupled to drive the drive roller 126 of roller assembly 74.

[0071] In an embodiment, the proximity sensor 36, or any other sensor or activation device described herein, initiates the operation of the dispensing unit 20. Alternatively, in the embodiments operating in a “hang mode”, the operation can be initiated by the actuation of the tear bar sensor 57 via the tear bar 75, when utilized. In an embodiment, the proximity sensor 36 is integrated with the main controller 38. The main controller 38 is between a front shroud 98 and the roller assembly 74. In an embodiment the proximity sensor 36 includes an optical emitter 100 and a receiver 102 covered by a lens 103 (the lens being depicted in an exploded assembly fashion in Figure 10), where the lens 103 is substantially flush with the front shroud 98. The emitter 100 and receiver 102 are spaced apart on the main controller 38 and oriented on an angle relative to the front of the sheet product dispenser 20. The emitter 100 transmits an optical signal, such as an infrared light for example, in a beam that extends outward on an angle 104 forming an emitter cone 108, shown in Figure 11. Similarly, the receiver 102 is responsive to signals received from a direction that extends outward on an angle 106 forming a receiver cone 110. In an embodiment the overlapping of the emitter cone 108 and the receiver cone 110 creates a four-sided polyhedron shaped area 112 that

represents an area where a user may place their hands to activate the dispensing unit 20. It should be noted that the above-mentioned polyhedron represents the area of high probability for triggering the dispenser. Areas outside the polyhedron shaped area 112, but still within the area of one of the cones 108, 110, may still result in triggering the dispenser, however, these areas may be less reliable or less consistent than the area 112. While an embodiment is described and illustrated employing an optical sensor 100, 102, it will be appreciated that any other sensor suitable for a purpose disclosed herein may be alternatively used, such as a capacitive sensor for example. While an embodiment is described and illustrated employing a four-sided polyhedron shaped area to define a sensing zone, it will be appreciated that any shaped sensing zone suitable for a purpose disclosed herein may be employed, such as a zone having a boundary simply defined by a sensitivity of a particular sensor for example.

[0072] It should be appreciated that the position of the area 112 will affect the functioning and the user experience with the dispensing unit 20. The area 112 needs to be large enough to allow the user an easy operation of the dispensing unit 20 without having the farthest distance “D” of the area 112 extend too far from the dispensing unit 20. While a large area is desirable, if the distance “D” becomes too large, someone passing by may accidentally dispense the sheet product 26. Further, the larger the area 112, the more quiescent power the proximity sensor 36 will use, decreasing battery life. In an embodiment, the emitter 100 and the receiver 102 are spaced a distance “W” of 3 inches (7.62 cm) apart, with the angles 104, 106 of cones 108, 110, respectively, each being from 10 to 80 degrees. This creates a polyhedron area 112 having a maximum distance “D” of 3 inches. The advantage of this arrangement is that it creates an area 112 that is large, reliable and convenient enough for the user while keeping the quiescent power requirements at less than or equal to 25% of the annual battery usage.

[0073] Referring now to Figure 12, an example drive motor assembly 45 will be described, with the understanding that such a drive motor assembly 45 is merely an example assembly and that other drive systems suitable for a purpose disclosed herein may be substituted for the example drive motor assembly 45 herein described. As discussed above, when a proximity sensor 36 is employed (see Figure 1) and the user activates the proximity sensor 36, a signal is transmitted to the main controller 38 (see Figures 3 and 7), which activates the drive motor assembly 45 (see Figure 9) to dispense the sheet product 26. The drive motor assembly 45 includes a motor 42 coupled to the chassis 82 by a flange 116. An

isolator 118 is arranged between the motor 42 and chassis 82. In an embodiment the isolator 118 is a rubber based polymer that provides damping to prevent transmission of vibrations from the motor 42 into the chassis 82 and the front cover 22 (see Figure 1). However, it will be appreciated that the isolator 118 is not limited to a rubber based polymer, and may alternatively be made of any other material suitable for a purpose disclosed herein. The motor 42 includes a shaft 120 that extends through an opening 121 in the chassis 82. A pulley 122 is mounted to the shaft 120. In the illustrated embodiment, the pulley 122 includes teeth sized to receive a toothed belt 138.

[0074] The roller assembly 74 (see Figure 7) includes a pinch roller 124 and a drive roller 126. Each of the rollers 124, 126 are rotatably coupled to a side plate 128, 130 that in turn mounts to the chassis 82. The drive roller 126 rotates about a shaft 132. A pulley 134 is mounted to the end of the shaft 132 adjacent the motor 42. The pulley 134 is secured to the shaft 132 by a drive flange 136.

[0075] The belt 138 couples the pulleys 122, 134. In the illustrated embodiment, the belt 138 is a toothed belt. The teeth on the belt 138 have a size and pitch suitable to engage the teeth on the pulleys 122, 134. In the illustrated embodiment, the belt 138 is made from a suitable material, including but not limited to: Neoprene, polyurethane, rubber, and urethane, reinforced with materials including but not limited to: polyaramid, glass, metallic fibers, other polymers fibers, or other reinforcing fibers. The combination of the belt 138 and the isolator 118 provides advantages over the prior art systems that use direct gear arrangement between the motor 42 and the drive roller 126. While gear systems provide a greater efficiency in the transfer of energy from the motor 42 to the drive roller 126, backlash and vibration in such an arrangement can create an undesirable noise, which is transferred into the dispensing unit 20 and vibrates front cover 22 for example, which acts as a sound amplifier. By using an isolator 118 and a belt 138, the transfer of vibrations from the motor 42 is minimized, resulting in little or no sound emissions from the dispensing unit 20.

[0076] Referring now to Figures 13-15, an example cartridge 25 for use in the dispensing unit 20 (also herein referred to as an electronic sheet product dispenser) is depicted. In the embodiment illustrated in Figure 13, the cartridge 25 includes an enclosure 200 formed from any material suitable for the purposes disclosed herein, such as a paper material or a plastic material for example, but in an embodiment being formed from folded cardboard having strategically placed bend lines and perforation lines, with a removable

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section 205 formed by perforation lines 210 that defines a dispensing opening 215 in the enclosure 200 when the removable section 205 is removed. Figure 14 depicts the cartridge 25 of Figure 13 with an end wall 220 not shown to expose sheet product 26 disposed within the enclosure 200, where the sheet product 26 is formed in the manner illustrated in Figure 6A and discussed above. Figure 15 depicts the cartridge of Figure 13 with an end wall 220 not shown to expose sheet product 26 disposed within the enclosure 200, where the sheet product 26 is formed into a roll 225 having two pivots 230 (only one pivot being depicted, the other pivot being hidden from view on the opposing end of the roll 225). While a z-folded sheet product 26 in the form depicted in Figure 6B, or a continuous z-fold sheet product discussed above, are not specifically illustrated, it will be appreciated that such z-folded sheet product (stack or continuous) could replace the stack of u-folded sheet product 26 depicted in Figure 17. Thus, Figure 17 should be understood to also depict z-folded sheet product (stack or continuous).

[0077] Referring now to Figures 16-17, two alternative embodiments are depicted to more specifically illustrate the pivot arrangement for the roll 225 of sheet product 26. In general, the illustrations of Figures 16-17 respectively depict inwardly extending protrusions 240, 250 on opposing ends of the enclosure 200 that define pivot surfaces upon which the pivots 230 of the roll 225 are disposed, where the roll 225 typically includes a cardboard core, but may also be coreless. In the embodiment illustrated in Figure 16, the inwardly extending protrusions 240 are cylindrically shaped trunnions formed from any material suitable for the purposes disclosed herein, such as molded plastic for example. In the embodiment illustrated in Figure 17, the inwardly extending protrusions 250 are formed from inwardly displaced portions of the opposing end walls 220 of enclosure 200, which may be formed as depicted in Figure 18 (a partial end view of one end wall 220) as a hexagonal pattern of cut lines 255 arranged within a circular pattern of perforated bend lines 260, where the hexagonal pattern of cut portions are then bent inwards. In the embodiment illustrated in Figure 17, the opposing end walls 220 are formed from cardboard.

[0078] While Figure 18 depicts a certain pattern of bend and cut lines forming hexagonal “pizza slice” sections that form the aforementioned pivot surfaces for roll 225, it will be appreciated that the scope of the invention is not limited to just this certain pattern, but rather encompasses any pattern of bend and cut lines, any pivot means arrangement that involves deformation of the end wall of the enclosure 200, or the addition of any pivot

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support means inside the enclosure 200, which would be suitable for the purposes disclosed herein.

[0079] Referring now to Figures 19-20 in combination with Figures 5A and 5B, a front plan view of an enclosure 200 of cartridge 25 is depicted having a deformable section 265 arranged in a first position (Figure 19), and in a second position (Figure 20). In the embodiment illustrated in Figures 19-20, the deformable section 265 is formed from cardboard having sufficient rigidity such that when placed in the second position it is suitable for supporting the cartridge 25 (enclosure 200 and sheet product 26 contained therein) against the influence of gravity when the cartridge 25 is engaged with the dispensing unit 20 via support rails 270 (see Figures 5A and 5B), and the combination (dispensing apparatus 10) is placed underneath a support structure, such as underneath a cabinet that is supported above a kitchen counter, for example. When arranged in the first position (Figure 19), the cartridge 25 with deformable section 265 is well suited for packaging, storing, and transporting.

[0080] Referring now to Figures 21-23, 24A and 24B, the cartridge 25, and a portion of the dispensing unit 20 (in a top-load cartridge arrangement) with receiving cavity 28, are depicted prior to installation of the cartridge 25 into the receiving cavity 28 (Figure 24A depicts an arrangement prior to installation, while Figure 24B depicts an arrangement after installation).

[0081] In an embodiment depicted in Figure 21, the enclosure 200 of cartridge 25 has a rejection feature 280 disposed and configured for communicating with a verification feature 290 on the dispensing unit 20, and in an embodiment depicted in Figure 22, the enclosure 200 of cartridge 25 has a rejection feature 285 disposed and configured for communicating with a verification feature 295 on the dispensing unit 20, where each respective rejection and verification feature prevents or at least deters use of an unauthorized cartridge 25.

[0082] In an embodiment, the rejection feature 280 is an indentation, void or recess disposed on the enclosure 200 (depicted in Figure 21 as a hole in the bottom of the enclosure 200), and the verification feature 290 is post or projection disposed on the floor of the cavity 28 of the dispensing unit 20. The post (referred to using reference numeral 290) has a shape complementary to that of the hole (referred to using reference numeral 280), where the two are aligned such that installation of an authorized cartridge 25 into the cavity 28 of dispensing unit 20 will permit proper alignment of the dispensing opening 21 of the cartridge 25 with the

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entry opening 23 of the dispensing unit 20 for proper dispensing of the sheet product 26 from the cartridge 25.

[0083] In another embodiment, the rejection feature 285 is a projection disposed on the enclosure 200 (depicted in Figure 22 as a half-cylinder projection on the end wall of the enclosure 200), and the verification feature 295 is a half-cylinder recess in an end wall of the cavity 28 of the dispensing unit 20. The half-cylinder projection (referred to using reference numeral 285) has a shape complementary to that of the half-cylinder recess (referred to using reference numeral 295), where the two are aligned such that installation of an authorized cartridge 25 into the cavity 28 of dispensing unit 20 will permit proper alignment of the dispensing opening 21 of the cartridge 25 with the entry opening 23 of the dispensing unit 20 for proper dispensing of the sheet product 26 from the cartridge 25. In an embodiment consistent with the features depicted in Figure 22, proper verification of an authorized cartridge 25 would further require use of an enable switch 320 (discussed further below), or the like, having a switch arm 325 disposed in the recess 295, which would fail to be actuated in the event of an unauthorized cartridge absent the projection 285 being inserted into the cavity 28.

[0084] While certain geometries of rejection features 280, 285 and verification features 290, 295 are depicted in Figures 21 and 22, it will be appreciated that the scope of the invention is not so limited, but rather encompasses any geometry of rejection/verification features suitable for the purposes disclosed herein. Such geometric rejection/verification features are collectively herein referred to as passive rejection/verification features.

[0085] While embodiments of the invention are described and illustrated employing an electronic sheet product dispenser 20, it will be appreciated that certain features, such as the cartridge and dispenser unit employing mechanical rejection and verification features as disclosed herein would be equally applicable to non-electronic sheet product dispensers configured in a manner suitable for a purpose disclosed herein. As such, non-electronic sheet product dispensers suitable for a purpose disclosed herein are also contemplated and considered within the scope of an invention disclosed herein.

[0086] In another embodiment, and with reference now to Figure 23 (in combination with Figure 7), the rejection feature 300 is provided in the form of an RFID tag disposed on the enclosure 200, an IR reflective surface disposed on the enclosure 200, a machine-

identifiable marking disposed on the enclosure 200, a magnetic region disposed on the enclosure 200, a machine-optically-recognizable character disposed on the enclosure 200, a phosphoresce region disposed on the enclosure 200, a starch marker disposed on the enclosure 200, an IC chip disposed on the enclosure 200, or a conductive strip, metallic or graphite for example, disposed on the enclosure 200. The verification feature 305 is complementary to the respective rejection feature so as to verify that an authorized cartridge 25 having the respective rejection feature is installed in the dispensing unit 20. As used herein, the term complementary refers to features that are complements of each other, that is, a verification feature would complement an associated rejection feature in a mechanical sense, an electrical sense, a magnetic sense, an electromagnetic sense, an optical sense, a signal communication sense, a communication protocol sense, or in any other manner suitable for a purpose disclosed herein where the verification feature is able to verify that an authorized cartridge is installed having the proper rejection feature designed to be associated with the respective verification feature. For example, where the rejection feature 300 is an RFID tag, the verification feature 305 is in the form of an RFID tag reader, where the rejection feature 300 is an IR reflective surface, the verification feature 305 is an IR sensor, where the rejection feature 300 is a machine-identifiable marking, the verification feature 305 is a marking sensor/reader, where the rejection feature 300 is a magnetic region, the verification feature 305 is a magnetic sensor/reader, where the rejection feature 300 is a machine-optically-recognizable character, the verification feature 305 is a character sensor/reader, where the rejection feature 300 is a phosphoresce region, the verification feature 305 is a phosphoresce sensor/reader, where the rejection feature 300 is a starch marker, the verification feature 305 is a starch sensor/reader, where the rejection feature 300 is an IC chip, the verification feature 305 is an IC chip sensor/reader, where the rejection feature 300 is a conductive strip on the enclosure 200, the verification feature 305 is a continuity measurement device, and where the rejection feature 302 is a conductive strip on a roll (core or coreless) 225, the verification feature 305 is a continuity measurement device. As depicted in Figure 7, the verification feature 305 is in signal communication with the main controller 38, thereby providing for verification of an authorized cartridge to be determined electronically via executable program instructions. In the event such a verification effort fails thereby indicating installation of an unauthorized cartridge, the main controller 38 could be programmed to prevent dispensing of sheet product. Such signal-communication-type rejection/verification features are collectively herein referred to as active rejection/verification features.

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[0087] It is contemplated that an embodiment utilizing a conductive strip as a form of a rejection feature may use, for example, a graphite impregnated strip or an aluminum foil strip that could be wound in the first few wraps of a roll of sheet product (see 302 in Figures 16 and 17), which could be core or coreless, as the rejection feature, and use a continuity measurement device (also herein referred to by reference numeral 305) as the verification feature.

[0088] While certain rejection features 280, 285, 300 have been described in relation to corresponding complementary verification features 290, 295, 305, it will be appreciated that more than one set of rejection and verification features may be employed in the same dispensing apparatus 10. Accordingly, the scope of the invention also encompasses any combination of the foregoing rejection features in the form of an indentation, a projection, an RFID tag, an IR reflective surface, a machine-identifiable marking, a magnetic region, a machine-optically-recognizable character, a phosphoresce region, a starch marker, and an IC chip, being used together with appropriate complementary verification features in the same dispensing apparatus 10.

[0089] Referring now to Figures 24A and 24B (in combination with Figure 7), an embodiment is disclosed that utilizes shutters that serve to cover the cavity 28 when a cartridge 25 is not coupled to the dispensing unit 20. Here, the cartridge 25, and a portion of the dispensing unit 20 (in a top-load cartridge arrangement) with receiving cavity 28, are depicted prior to installation of the cartridge 25 into the receiving cavity 28 (Figure 24A), and after installation of the cartridge 25 into the receiving cavity 28 (Figure 24B). Prior to installation of the cartridge 25 into the receiving cavity 28, shutters 310 are hinged 315 at upper edges of opposing side walls of the receiving cavity 28 and biased so as to close off the receiving cavity 28 when no cartridge 25 is installed. An enable switch 320 is disposed within the chassis 82, with a switch arm 325 that extends into the receiving cavity 28. Upon installation of the cartridge 25 into the receiving cavity 28 (see Figure 24B), the shutters 310 are caused to pivot downward with sufficient displacement so as to interact with the switch arm 325 causing actuation of the enable switch 320. Referring to Figure 7, enable switch 320 is in signal communication with the main controller 38, which provides for notification of an enable signal to inform main controller 38 that a cartridge 25 is in place ready for dispensing sheet product 26. In turn, main controller 38 enables all necessary dispensing functions of the dispensing unit 20 via executable program instructions. Absent an enable signal from

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enable switch 320 (that is, there is no cartridge 25 installed), dispensing unit 20 will not operate. Enable switch 320 is any switch suitable for the purposes disclosed herein, and may be but is not limited to a micro switch, a reed switch, a lever-actuated switch, a plunger-actuated switch, a magnetically-actuated switch, or the like.

[0090] In another embodiment, the shutters 310 are not employed, and the cartridge 25 itself interacts with the switch arm 325 causing actuation of the enable switch 320 during installation of the cartridge 25 into the receiving cavity 28.

[0091] While embodiments of the invention have been disclosed and described in relation to a top-load cartridge arrangement where the cartridge 25 loads into the top of the dispensing unit 20, it will be appreciated from Figures 3A, 4A and 5A, that front and bottom load cartridge arrangements are also considered within the scope of the invention. And while not specifically illustrated, it will also be appreciated that side-load cartridge arrangements are also contemplated and considered within the scope of the invention. With such front, bottom and side load arrangements, it is understood that one skilled in the art will be well informed from the disclosure herein to be able to appropriately rearrange the components of the dispensing unit 20 relative to the respective cartridge 25, without undue experimentation, so as to provide for proper dispensing of sheet product 26, thereby enabling one skilled in the art to make and use any embodiment disclosed herein.

[0092] While certain combinations of features have been described herein, it will be appreciated that these certain combinations are for illustration purposes only and that any combination of any of the disclosed features may be employed in accordance with an embodiment of the invention. Any and all such combinations are contemplated herein and are considered within the scope of the invention disclosed.

[0093] Some embodiments disclosed herein may provide one or more of the following advantages: hands free hygienic dispensing of sheet product from a conveniently located compact dispensing apparatus; an exposed cartridge that can be color coordinated with interior décor; hang mode or on-demand mode operation; a dispensing unit that can receive cartridges of different sizes, where the length and depth of the cartridges are constant, but the height varies to provide for different quantities of sheet product (standard and super-sized for example); a means for visually seeing the amount of sheet product remaining in a

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cartridge; a means for displaying messages on the dispensing unit; and, means for deterring use of an unauthorized cartridge.

[0094] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims. Also, in the drawings and the description, there have been disclosed example embodiments of the invention and, although specific terms may have been employed, they are unless otherwise stated used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention therefore not being so limited. Moreover, the use of the terms first, second, front, rear, top, bottom etc. do not denote any orientation, order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

What is claimed is:

1. A dispensing apparatus combination for dispensing sheet product, the dispensing apparatus combination comprising:
 - a cartridge comprising:
 - an enclosure comprising a cartridge opening; and
 - sheet product disposed within the enclosure and configured to be dispensed through the cartridge opening; and
 - a sheet product dispensing unit comprising:
 - a housing comprising:
 - a plurality of walls each comprising an interior surface and an exterior surface, the interior surfaces of the walls defining an interior space therebetween;
 - a receiving port defined along the exterior surface of one or more of the walls and configured to receive at least a portion of the cartridge therein;
 - an entry opening extending through one or more of the walls and disposed proximate the receiving port, the entry opening configured to allow the sheet product to pass from the cartridge into the interior space; and
 - a dispensing opening extending through one or more of the walls and spaced apart from the entry opening, the dispensing opening configured to allow the sheet product to pass from the interior space out of the housing; and
 - a drive mechanism disposed within the interior space and configured to dispense the sheet product from the interior space out of the housing, the drive mechanism comprising:
 - a motor; and
 - a drive roller disposed in operable communication with the motor;
 - wherein the cartridge is configured to be disposed in operable communication with the sheet product dispensing unit such that the cartridge opening is disposed within the receiving port and proximate the entry opening.
 - 2. The dispensing apparatus combination of Claim 1, wherein the cartridge is configured to be disposed in operable communication with the sheet product dispensing unit such that a first portion of the cartridge is disposed within the receiving port and a second portion of the cartridge is disposed outside of the receiving port.

3. The dispensing apparatus combination of Claim 1, wherein:
 - the sheet product dispensing unit further comprises a sensor disposed in signal communication with the drive mechanism; and
 - the drive mechanism is responsive to a dispense signal from the sensor to dispense the sheet product from the interior space out of the housing.
4. The dispensing apparatus combination of Claim 1, wherein the sheet product is a roll of sheet product, a plurality of interfolded sheet product leaves, or a continuous z-fold sheet.
5. The dispensing apparatus combination of Claim 1, wherein:
 - the sheet product dispensing unit further comprises an actuation mechanism disposed in operable communication with the motor and configured to facilitate actuation of the motor; and
 - the actuation mechanism comprises a proximity sensor, a manual pushbutton, or a tear bar sensor.
6. The dispensing apparatus combination of Claim 1, wherein:
 - the sheet product dispensing unit further comprises a verification feature; and
 - the cartridge further comprises a rejection feature configured to operably communicate with the verification feature when the cartridge is disposed in operable communication with the sheet product dispensing unit to verify that the cartridge is authorized for use with the sheet product dispensing unit.
7. The dispensing apparatus combination of Claim 1, wherein:
 - the sheet product dispensing unit further comprises an enable switch configured to engage the cartridge when the cartridge is disposed in operable communication with the sheet product dispensing unit; and
 - the enable switch is disposed in signal communication with the drive mechanism and configured to enable dispensing of the sheet product from the cartridge when the enable switch engages the cartridge.
8. The dispensing apparatus combination of Claim 6, wherein:
 - the rejection feature comprises an indentation disposed on the enclosure, a projection disposed on the enclosure, an RFID tag disposed on the enclosure, an IR reflective surface disposed on the enclosure, a machine-identifiable marking disposed on the enclosure, a

magnetic region disposed on the enclosure, a machine-optically-recognizable character disposed on the enclosure, a phosphoresce region disposed on the enclosure, a starch marker disposed on the enclosure, an IC chip disposed on the enclosure, a conductive strip disposed on the enclosure, a conductive strip disposed on the sheet product, or any combination of the foregoing indentation, projection, RFID tag, IR reflective surface, machine-identifiable marking, magnetic region, machine-optically-recognizable character, phosphoresce region, starch marker, IC chip, and conductive strip; and

the verification feature is complementary to the respective rejection feature and configured to verify that an authorized cartridge having the respective rejection feature is disposed in operable communication with the sheet product dispensing unit.

9. A sheet product dispensing unit for dispensing sheet product from a cartridge, the sheet product dispensing unit comprising:

a housing comprising:

a plurality of walls each comprising an interior surface and an exterior surface, the interior surfaces of the walls defining an interior space therebetween;

a receiving port defined along the exterior surface of one or more of the walls and configured to receive at least a portion of the cartridge therein;

an entry opening extending through one or more of the walls and disposed proximate the receiving port, the entry opening configured to allow the sheet product to pass from the cartridge into the interior space; and

a dispensing opening extending through one or more of the walls and spaced apart from the entry opening, the dispensing opening configured to allow the sheet product to pass from the interior space out of the housing;

a drive mechanism disposed within the interior space and configured to dispense the sheet product from the interior space out of the housing; and

a sensor disposed in signal communication with the drive mechanism;

wherein the drive mechanism is responsive to a dispense signal from the sensor to dispense the sheet product from the interior space out of the housing.

10. The sheet product dispensing unit of Claim 9, further comprising an actuation mechanism, wherein:

the drive mechanism comprises a motor, a drive roller disposed in operable communication with the motor, and a pinch roller disposed proximate the drive roller;

the actuation mechanism is disposed in operable communication with the motor and configured to facilitate actuation of the motor; and

the drive roller and the pinch roller are disposed proximate the dispensing opening and configured to facilitate dispensing of the sheet product from the interior space through the dispensing opening and out of the housing.

11. The sheet product dispensing unit of Claim 9, wherein:

the drive mechanism is responsive to a dispense signal from the sensor to dispense the sheet product on demand; and

the sensor is responsive to a user causing the sensor to generate the dispense signal in an on-demand-mode manner.

12. The sheet product dispensing unit of Claim 9, wherein the sheet product is a roll of sheet product, a plurality of interfolded sheet product leaves, or a continuous z-fold sheet.

13. The sheet product dispensing unit of Claim 9, further comprising an enable switch configured to engage the cartridge when the cartridge is disposed within the receiving port, wherein the enable switch is disposed in signal communication with the drive mechanism and configured to enable dispensing of the sheet product from the cartridge when the enable switch engages the cartridge.

14. The sheet product dispensing unit of Claim 10, further comprising:

a controller disposed in operable communication with the motor and configured to facilitate actuation of the motor; and

a verification feature disposed in operable communication with the receiving port and the controller;

wherein the verification feature is configured to operably communicate with a rejection feature of the cartridge, to verify that an authorized cartridge having the rejection feature is disposed in the receiving port, and to communicate such verification to the controller.

15. The sheet product dispensing unit of Claim 10, wherein the actuation mechanism comprises a proximity sensor, a manual pushbutton, or a tear bar sensor.

16. A cartridge for a sheet product dispensing unit, the cartridge comprising:
an enclosure comprising a cartridge opening;
sheet product disposed within the enclosure and configured to be dispensed through the cartridge opening; and
a rejection feature configured to operably communicate with a verification feature of the sheet product dispensing unit to verify that the cartridge is authorized for use with the sheet product dispensing unit;
wherein the rejection and verification features comprise complementary active rejection and verification features.
17. The cartridge of Claim 16, wherein the rejection feature comprises an RFID tag disposed on the enclosure, an IR reflective surface disposed on the enclosure, a machine-identifiable marking disposed on the enclosure, a magnetic region disposed on the enclosure, a machine-optically-recognizable character disposed on the enclosure, a phosphoresce region disposed on the enclosure, a starch marker disposed on the enclosure, an IC chip disposed on the enclosure, a conductive strip disposed on the enclosure, or a conductive strip disposed on the sheet product.
18. The cartridge of Claim 16, further comprising inwardly extending protrusions disposed about opposing ends of the enclosure, wherein the sheet product is a roll of sheet product pivotally supported by the inwardly extending protrusions.
19. The cartridge of Claim 18, wherein the inwardly extending protrusions are cylindrically shaped trunnions.
20. The cartridge of Claim 18, wherein the inwardly extending protrusions are formed from inwardly displaced portions of the opposing ends of the enclosure.
21. The cartridge of Claim 16, wherein the sheet product is a plurality of discrete sheets configured to be dispensed through the cartridge opening one after the other in succession.
22. The cartridge of Claim 21, wherein the discrete sheets are interfolded u-fold sheets or interfolded z-fold sheets.

23. The cartridge of Claim 16, wherein:

the enclosure further comprises at least one deformable section movable from a first position suitable for packaging, storing and transporting, to a second position suitable for engagement with the sheet product dispensing unit; and

the at least one deformable section is configured to support the enclosure against the influence of gravity when the at least one deformable section is disposed in the second position and engages the sheet product dispensing unit.

24. The cartridge of Claim 16, wherein:

the enclosure further comprises a removable section defining the cartridge opening; and

the sheet product is configured to be dispensed through the cartridge opening subsequent to removal of the removable section.

25. The dispensing apparatus combination of Claim 1, wherein one of the walls is disposed between the receiving port and the interior space, and wherein the entry opening extends through the one of the walls.

26. The dispensing apparatus combination of Claim 1, wherein the receiving port is defined along the exterior surface of a top wall of the housing.

27. The sheet product dispensing unit of Claim 9, wherein one of the walls is disposed between the receiving port and the interior space, and wherein the entry opening extends through the one of the walls.

28. The sheet product dispensing unit of Claim 9, wherein the receiving port is defined along the exterior surface of a top wall of the housing.

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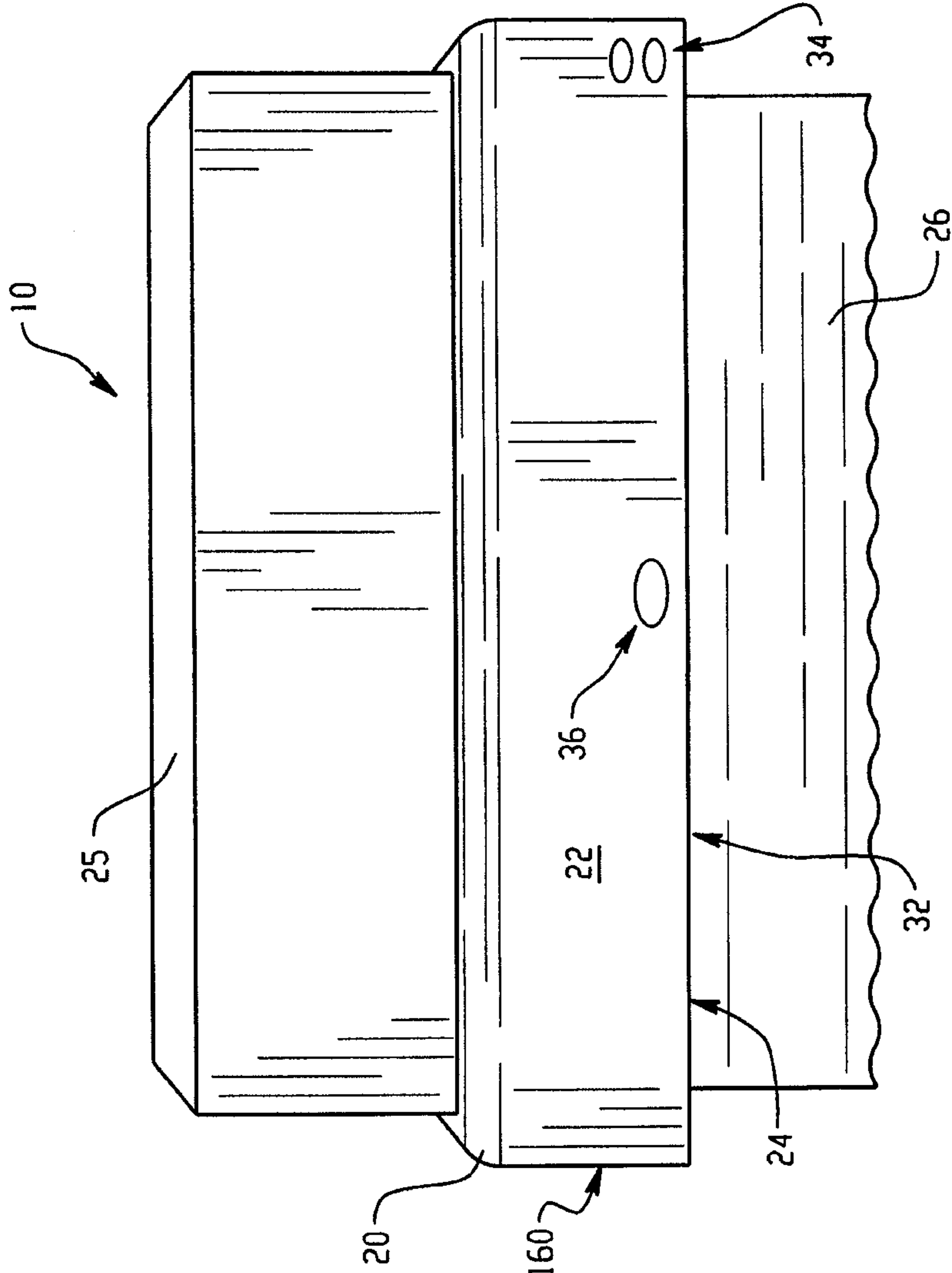


Fig. 1A

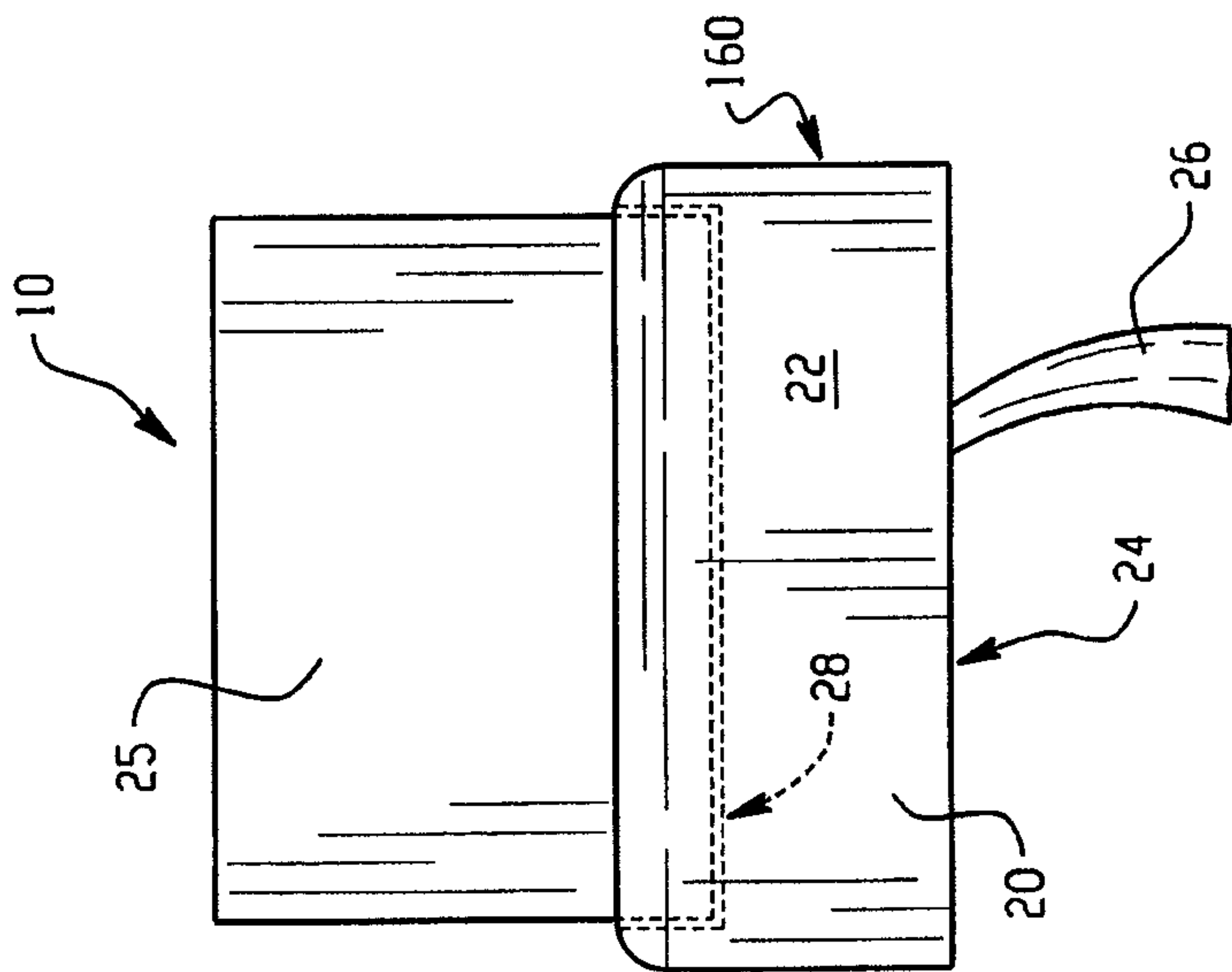


Fig. 1B

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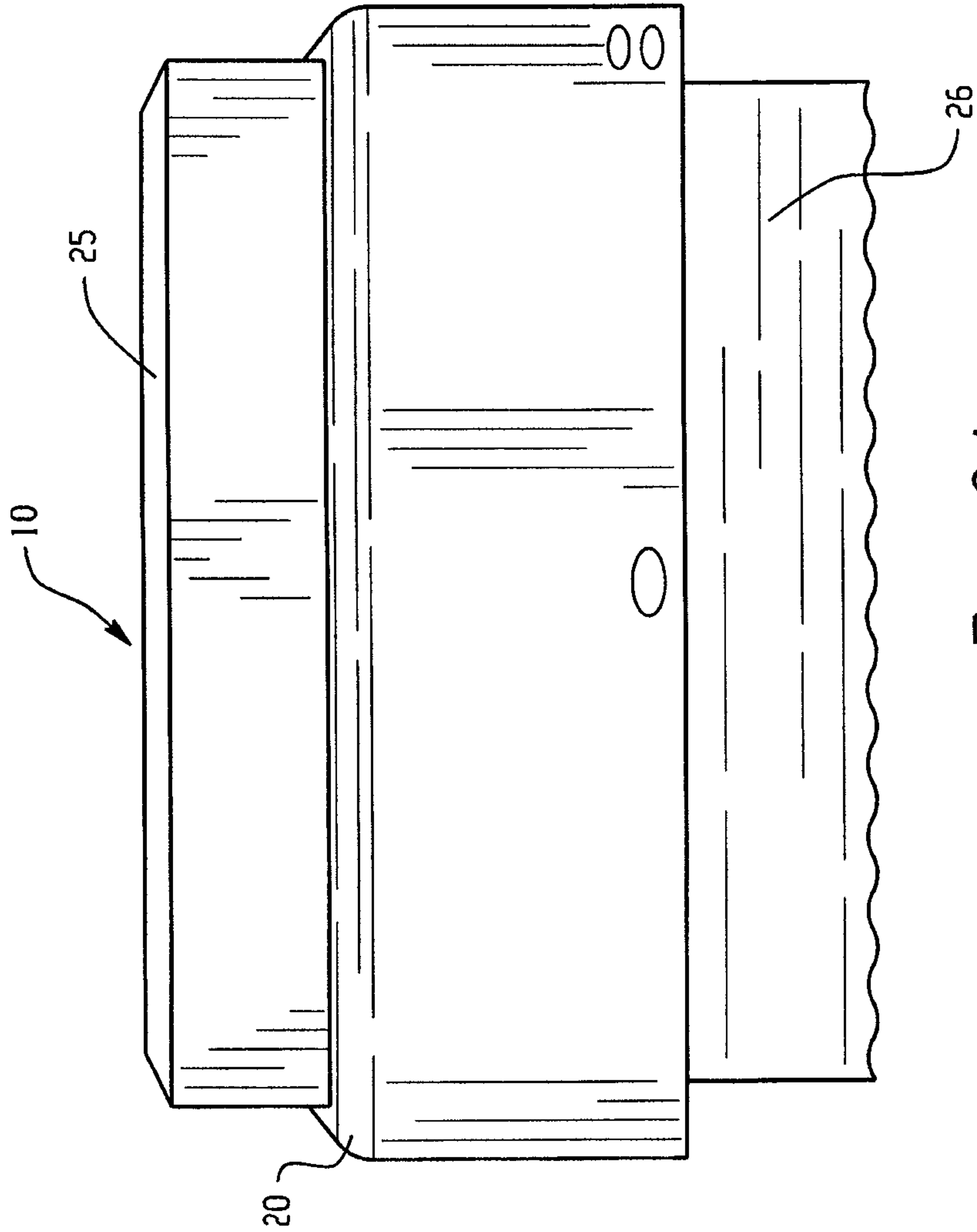


Fig. 2A

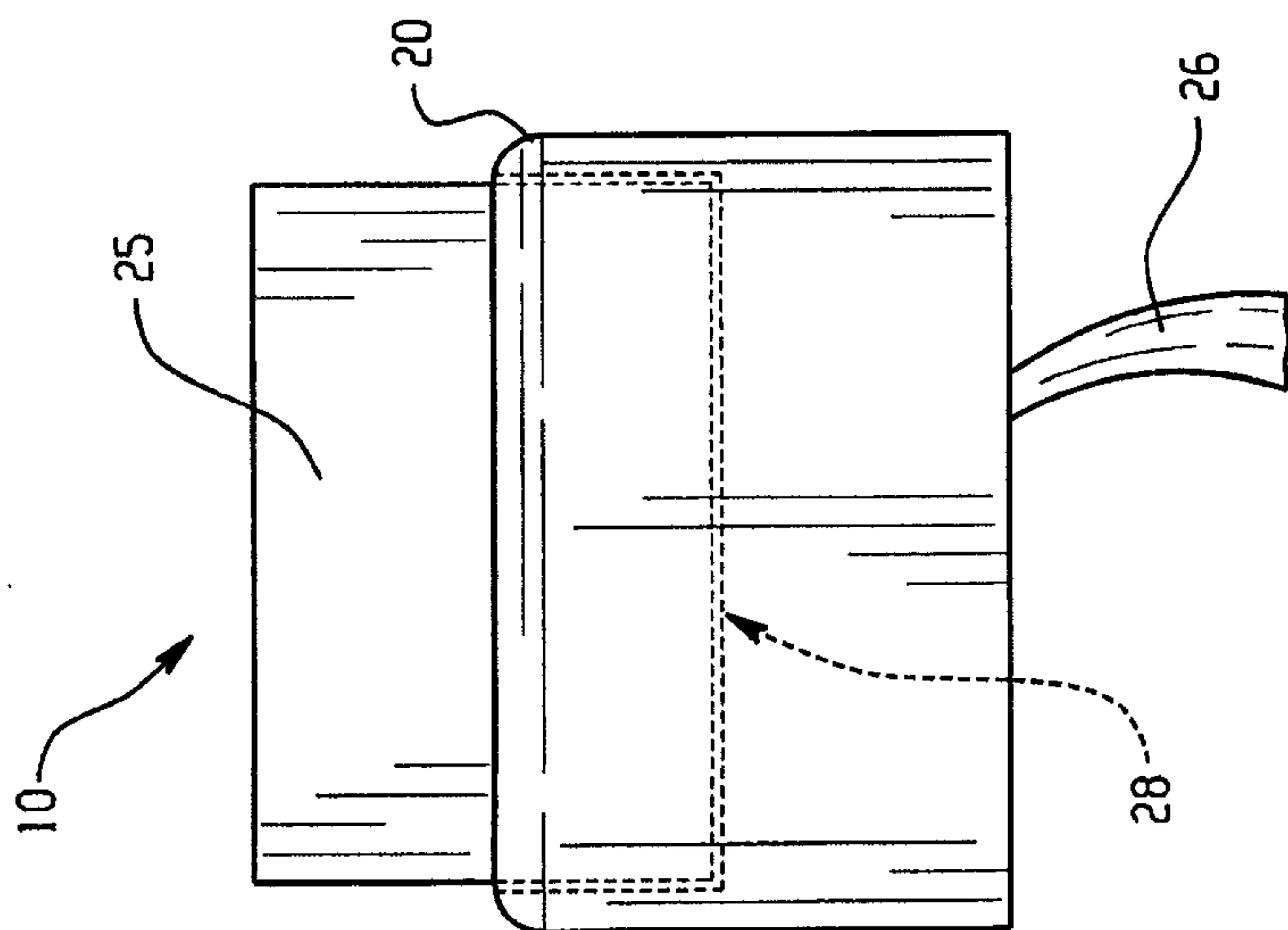


Fig. 2B

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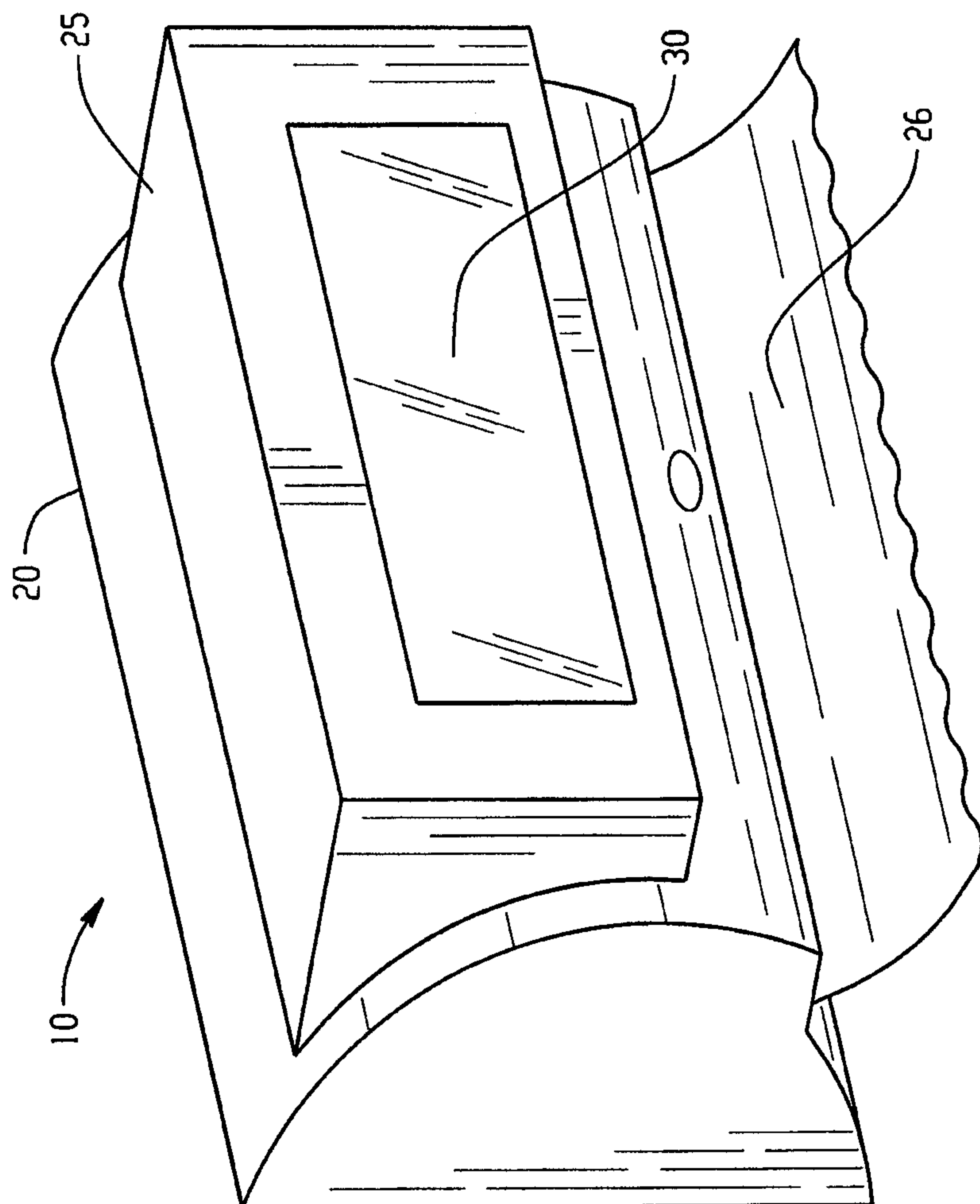


Fig. 3A

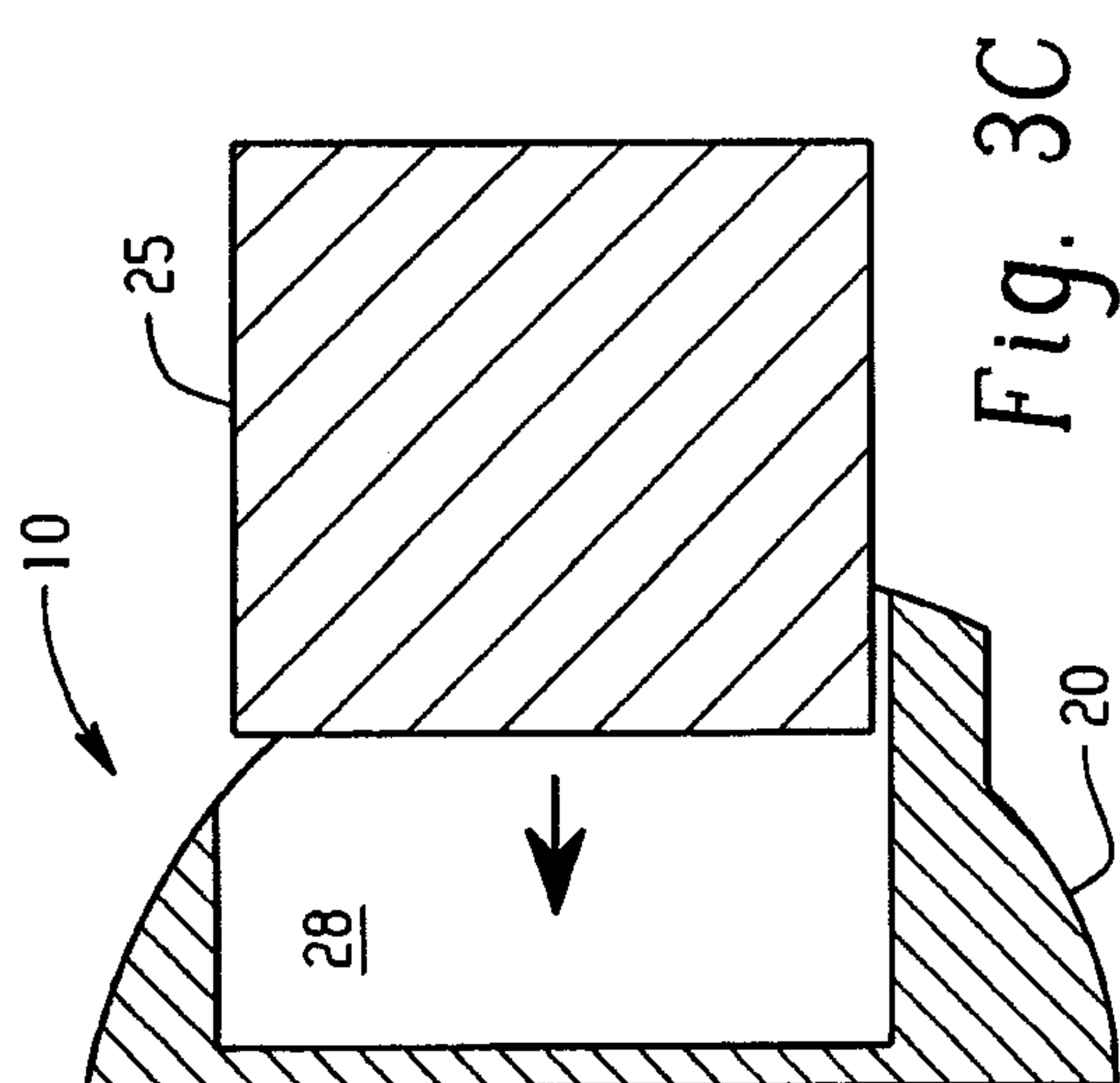


Fig. 3C

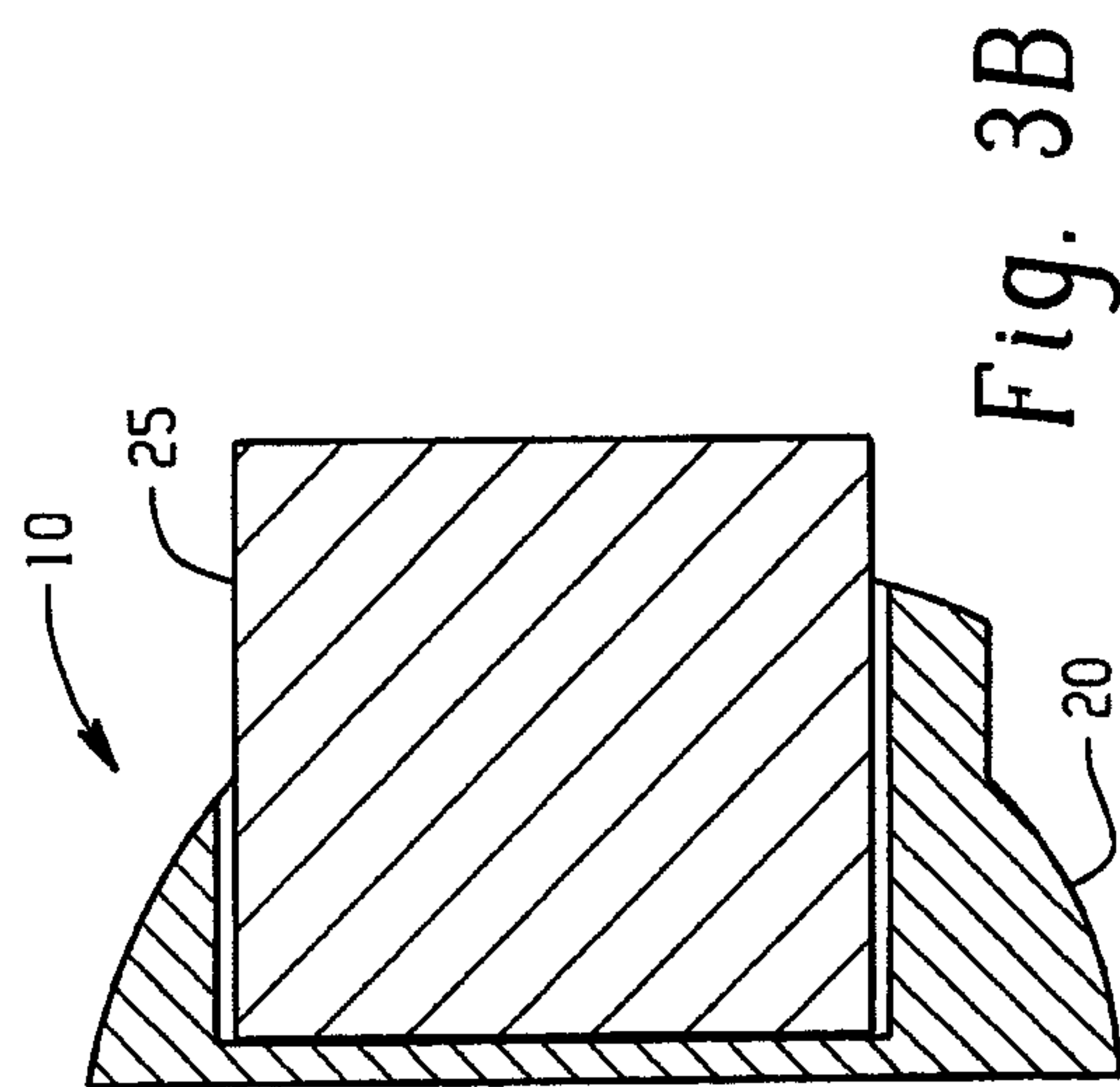
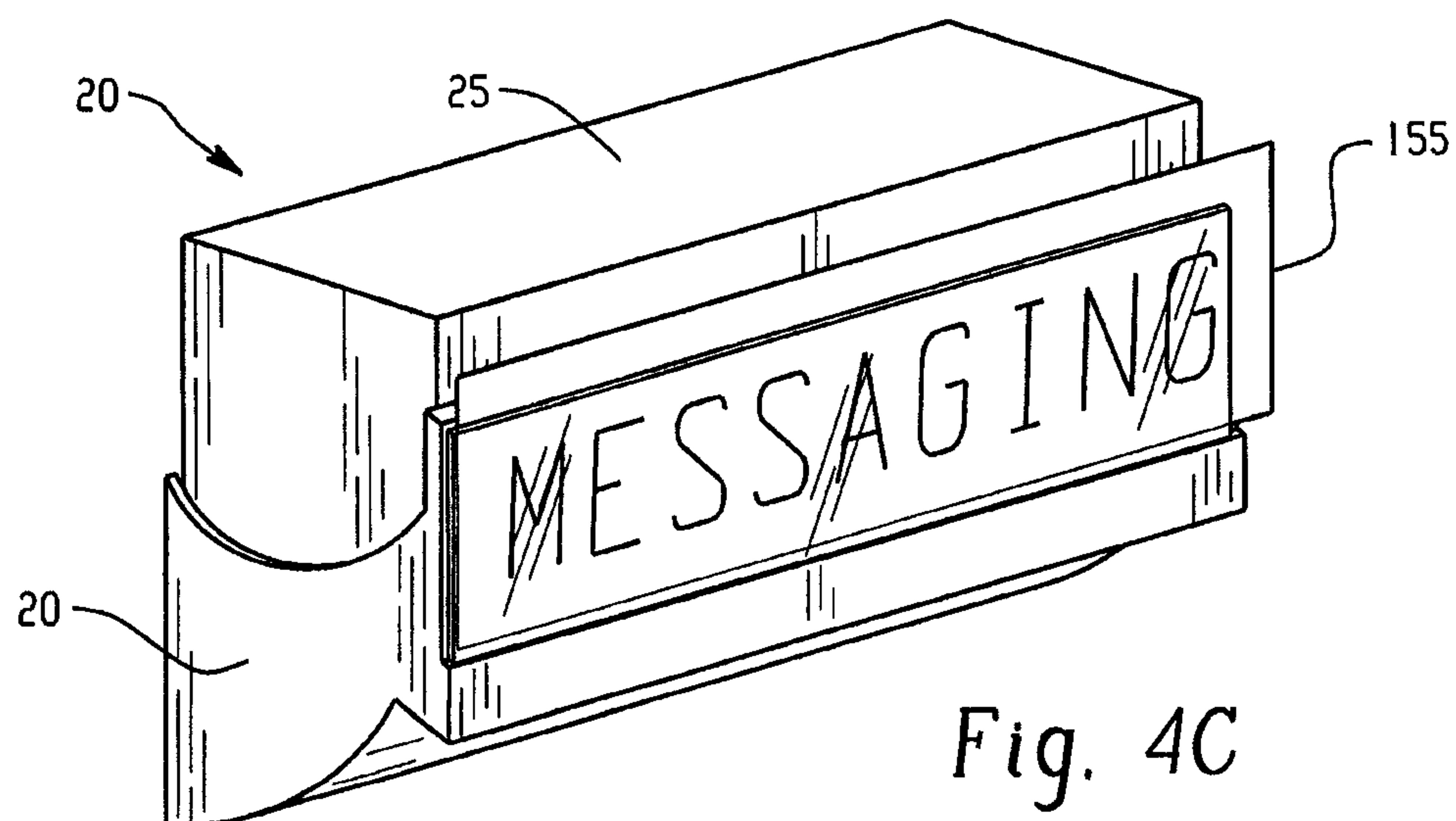
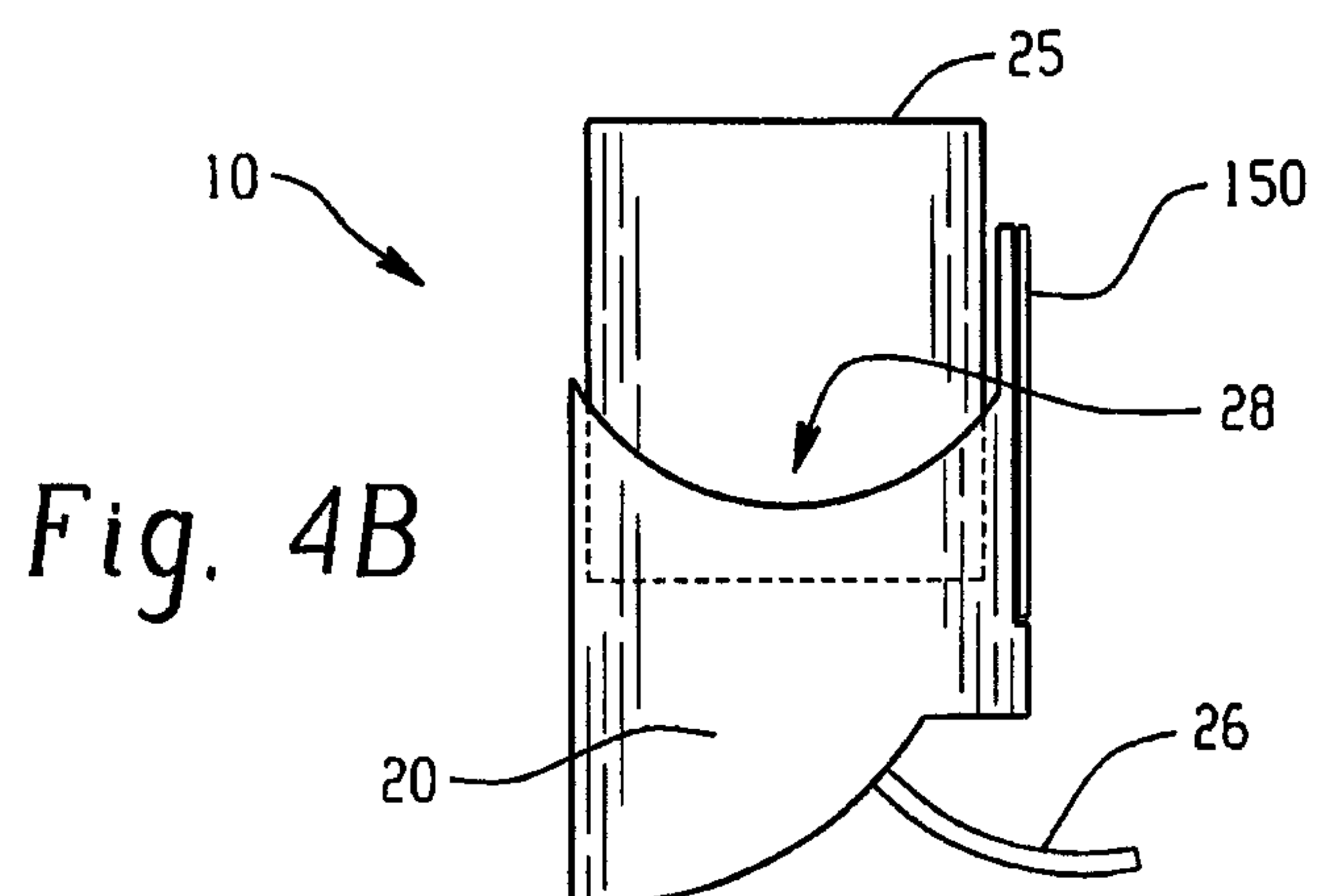
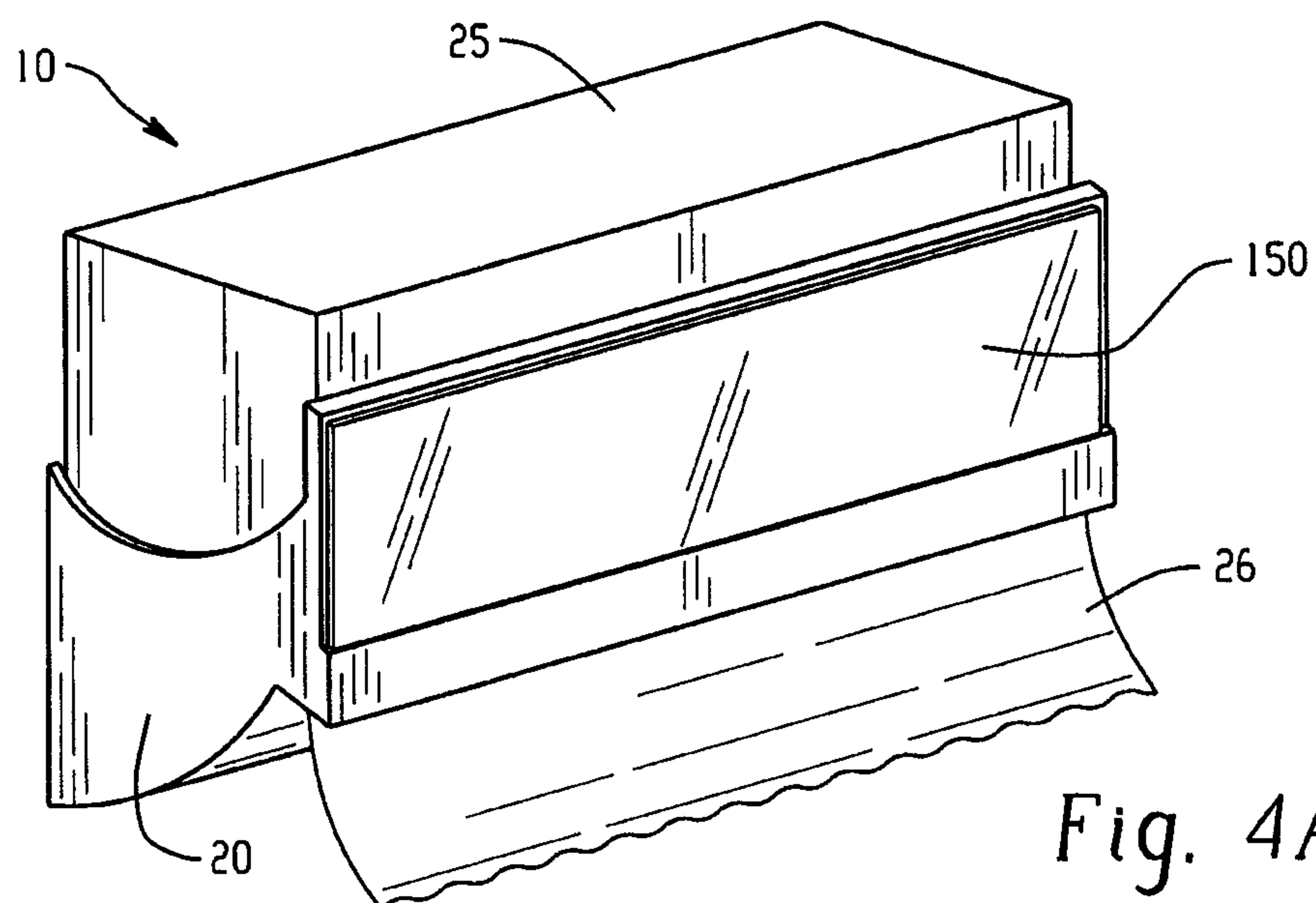


Fig. 3B

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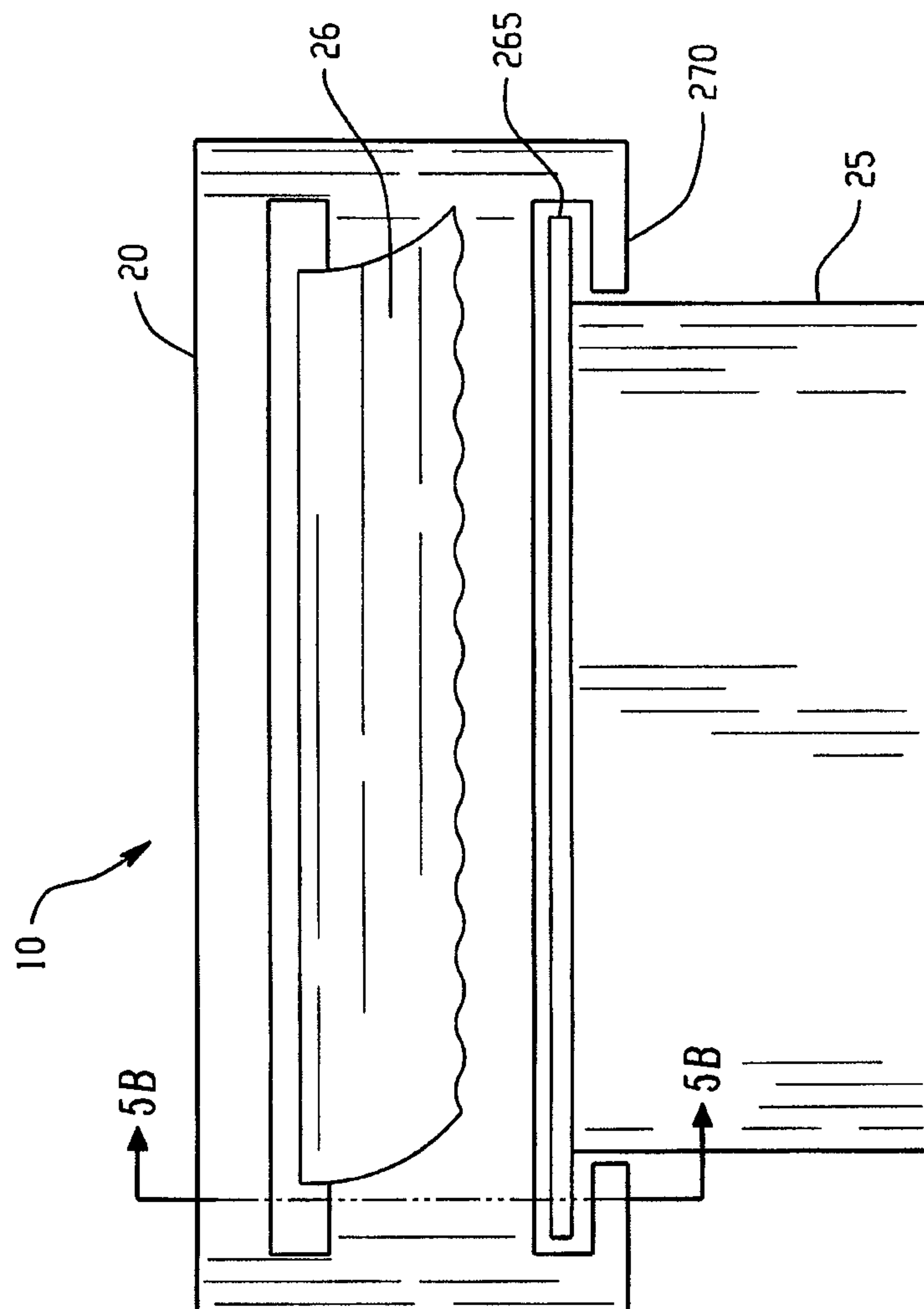


Fig. 5A

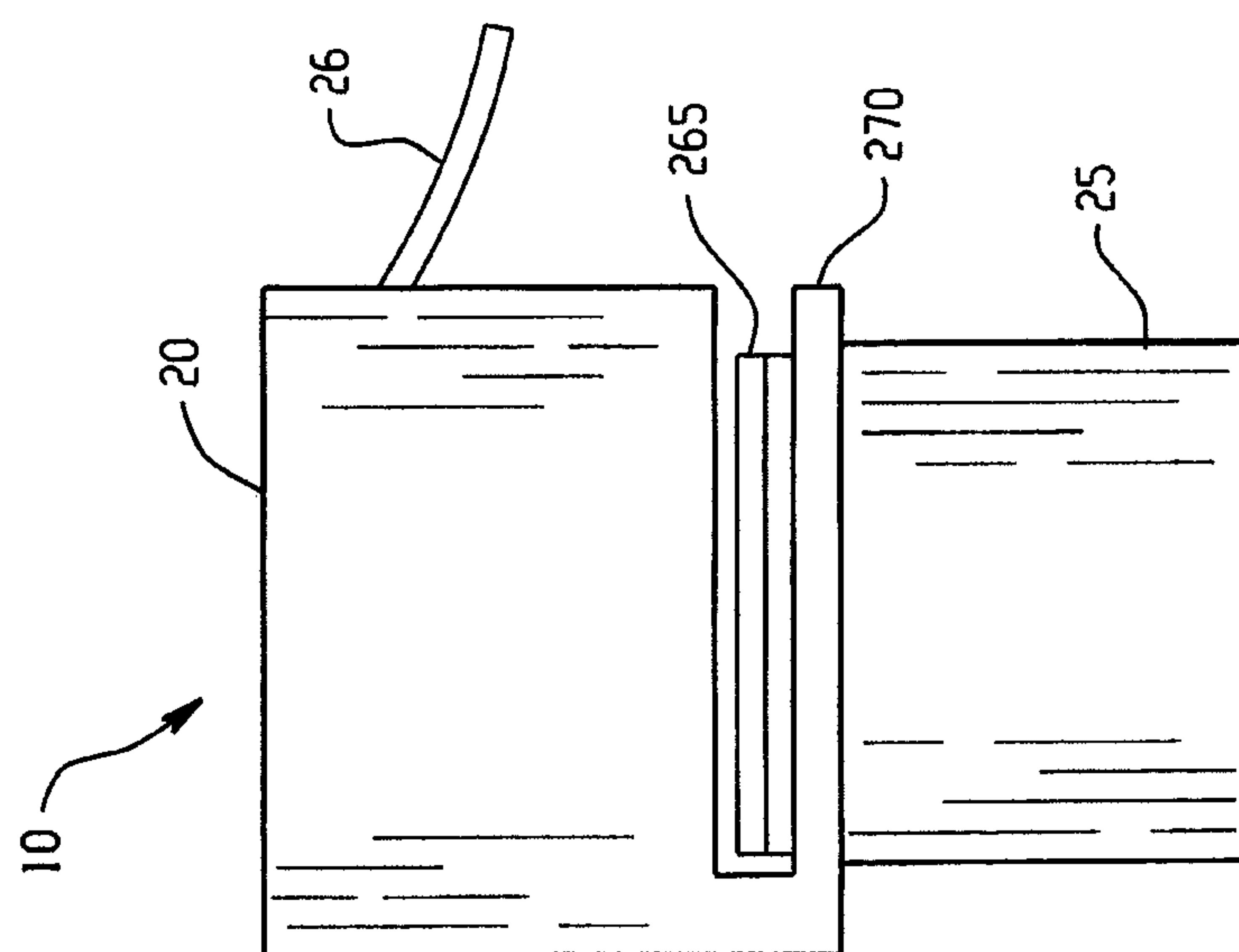


Fig. 5B

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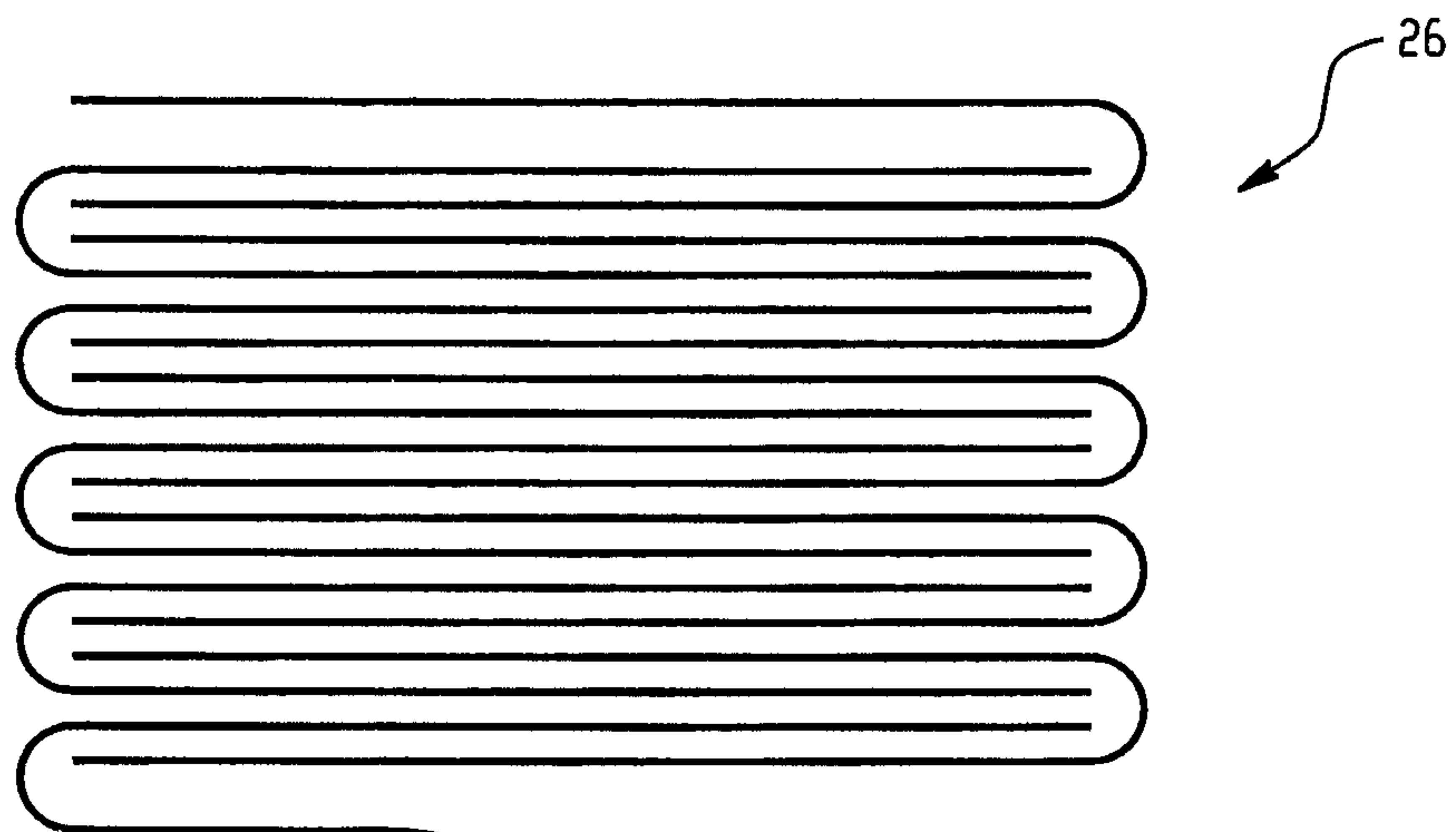


Fig. 6A

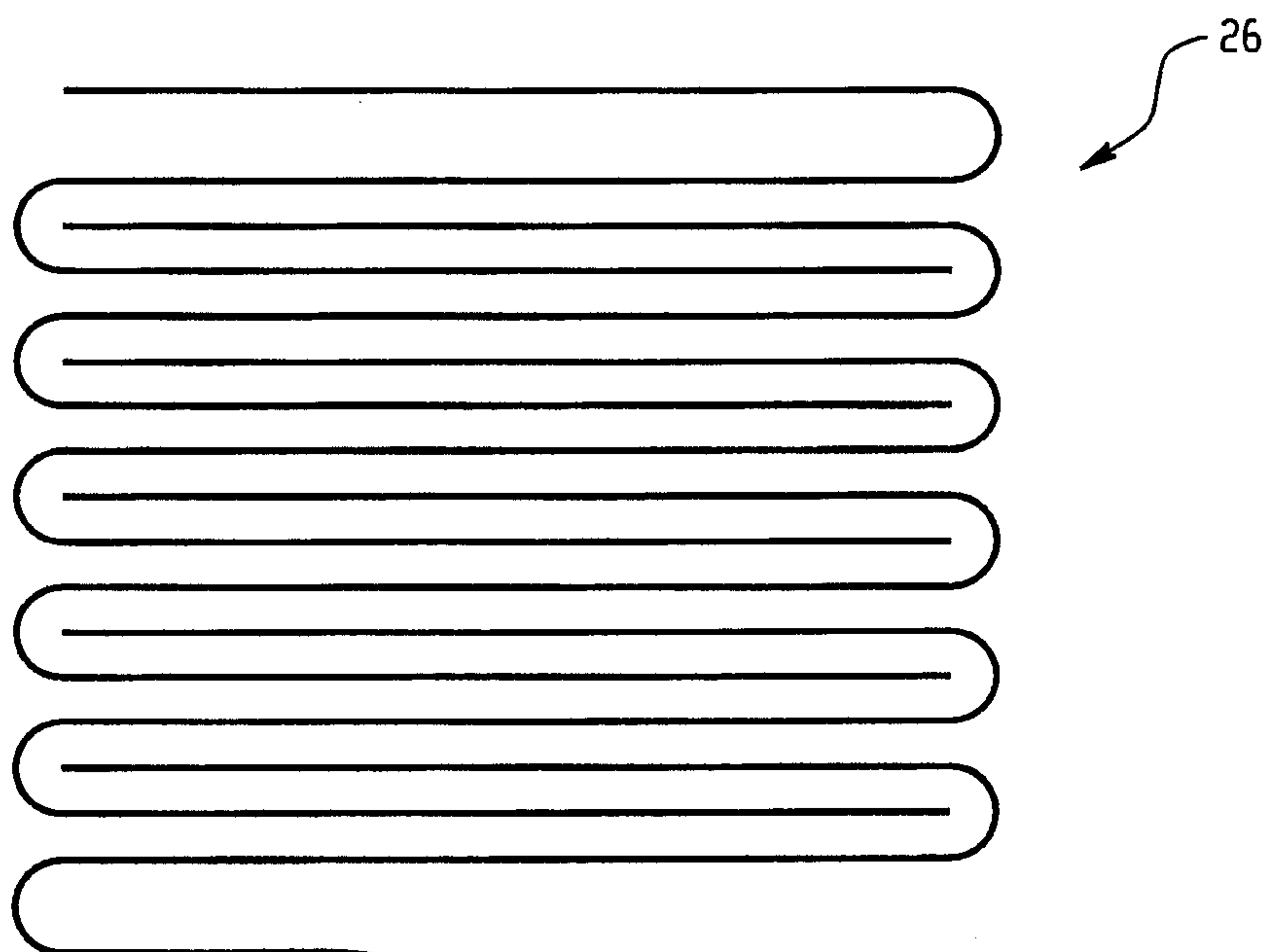


Fig. 6B

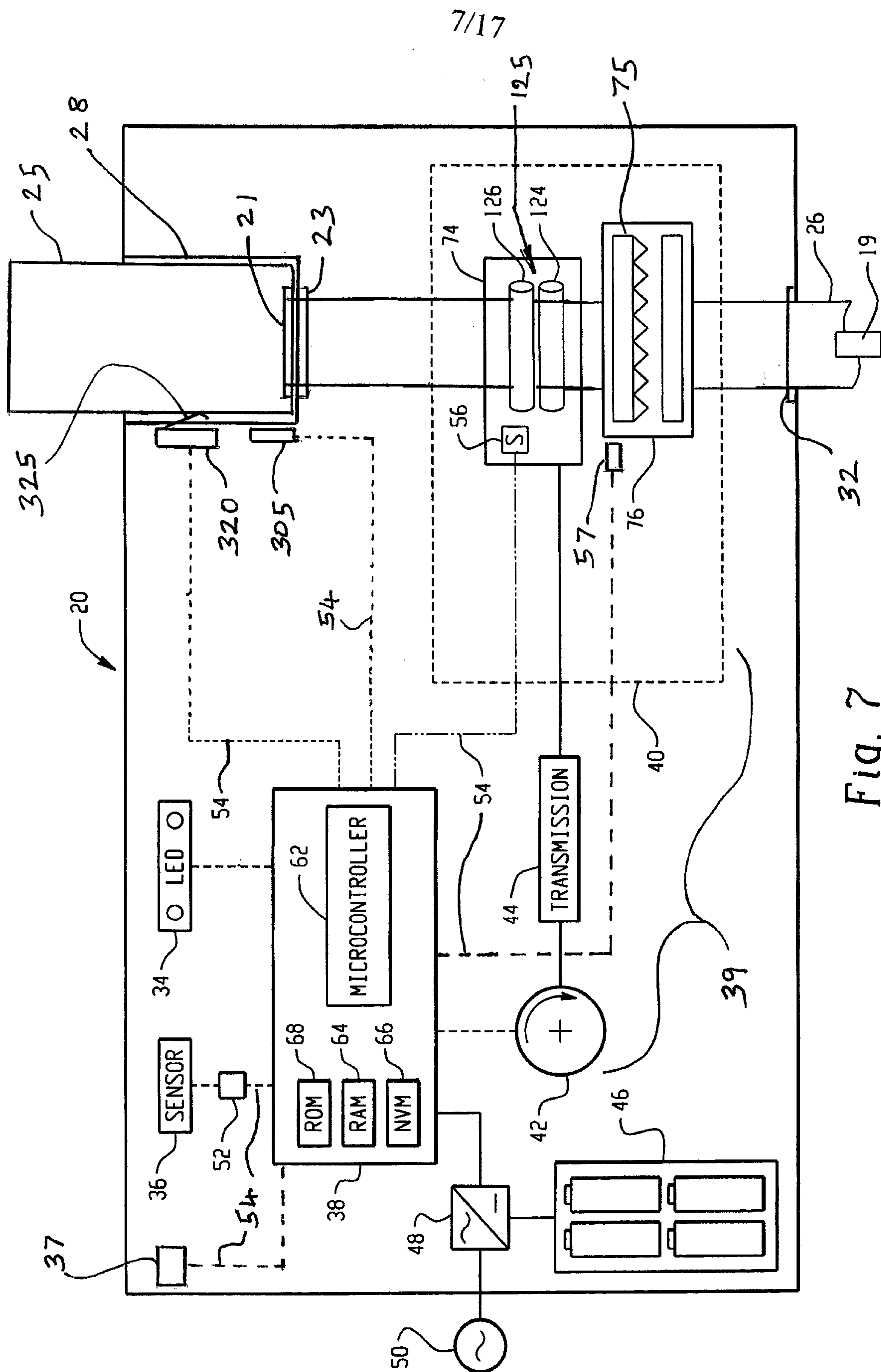


Fig. 7

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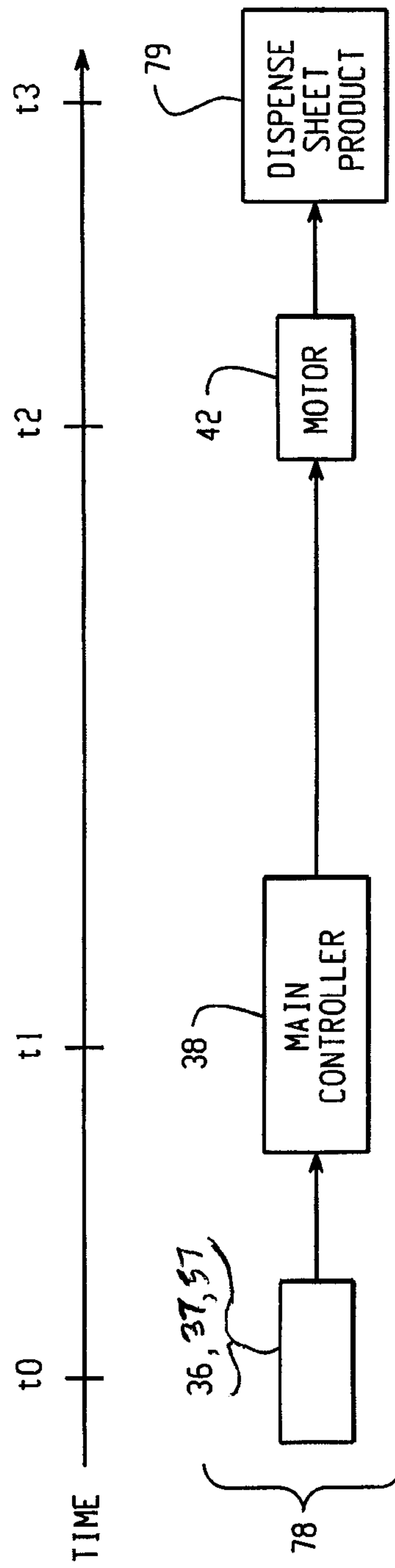
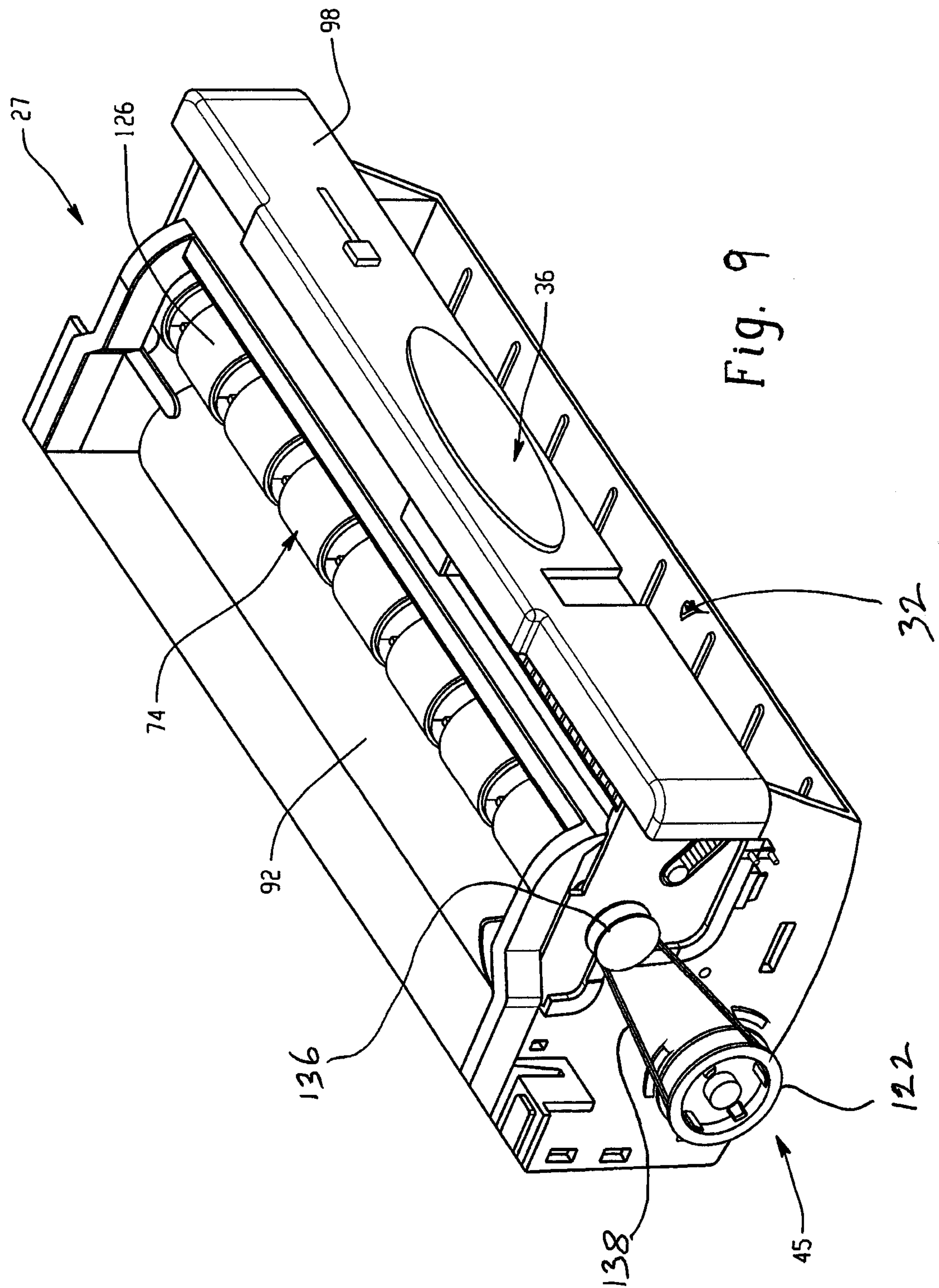


Fig. 8

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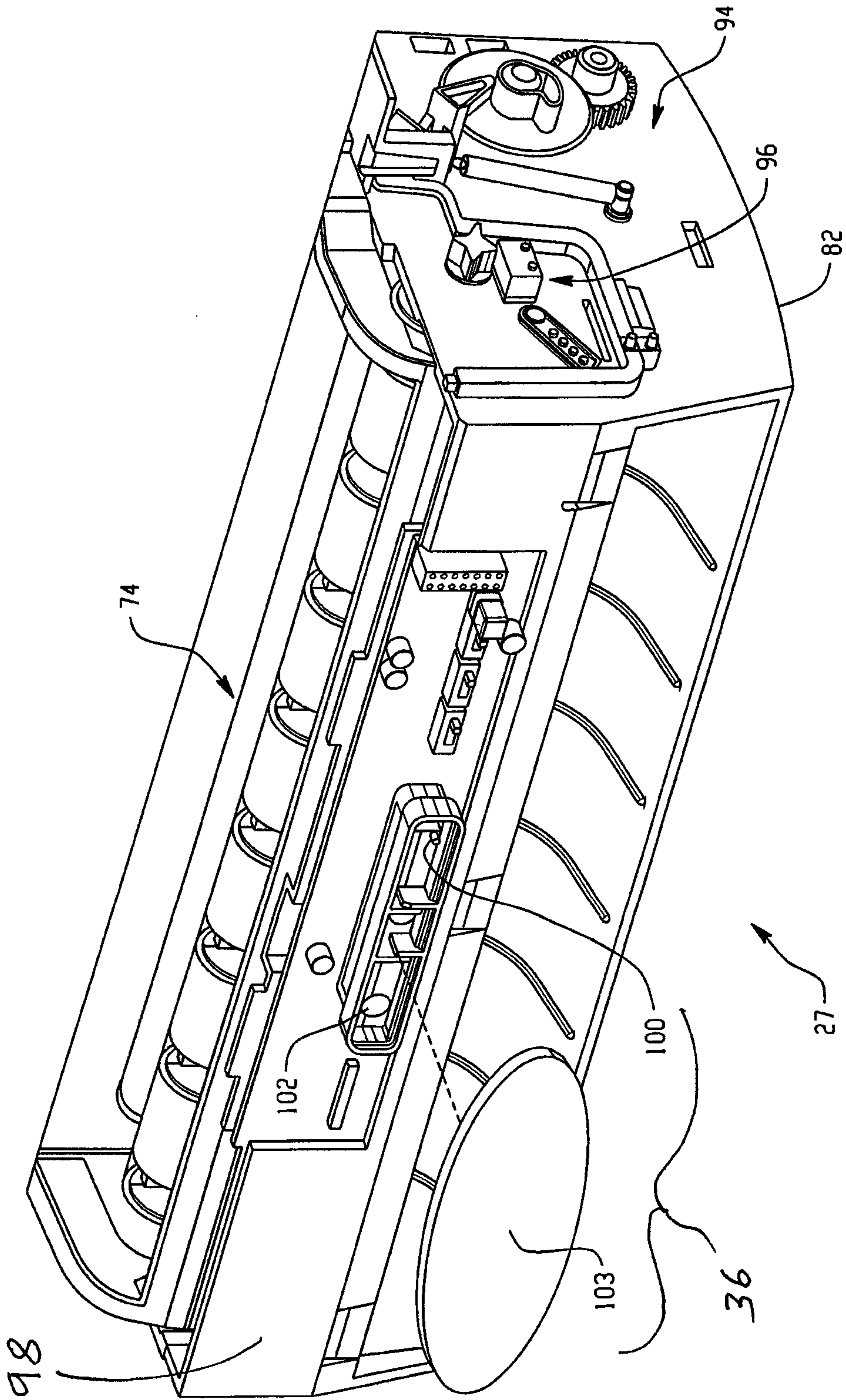
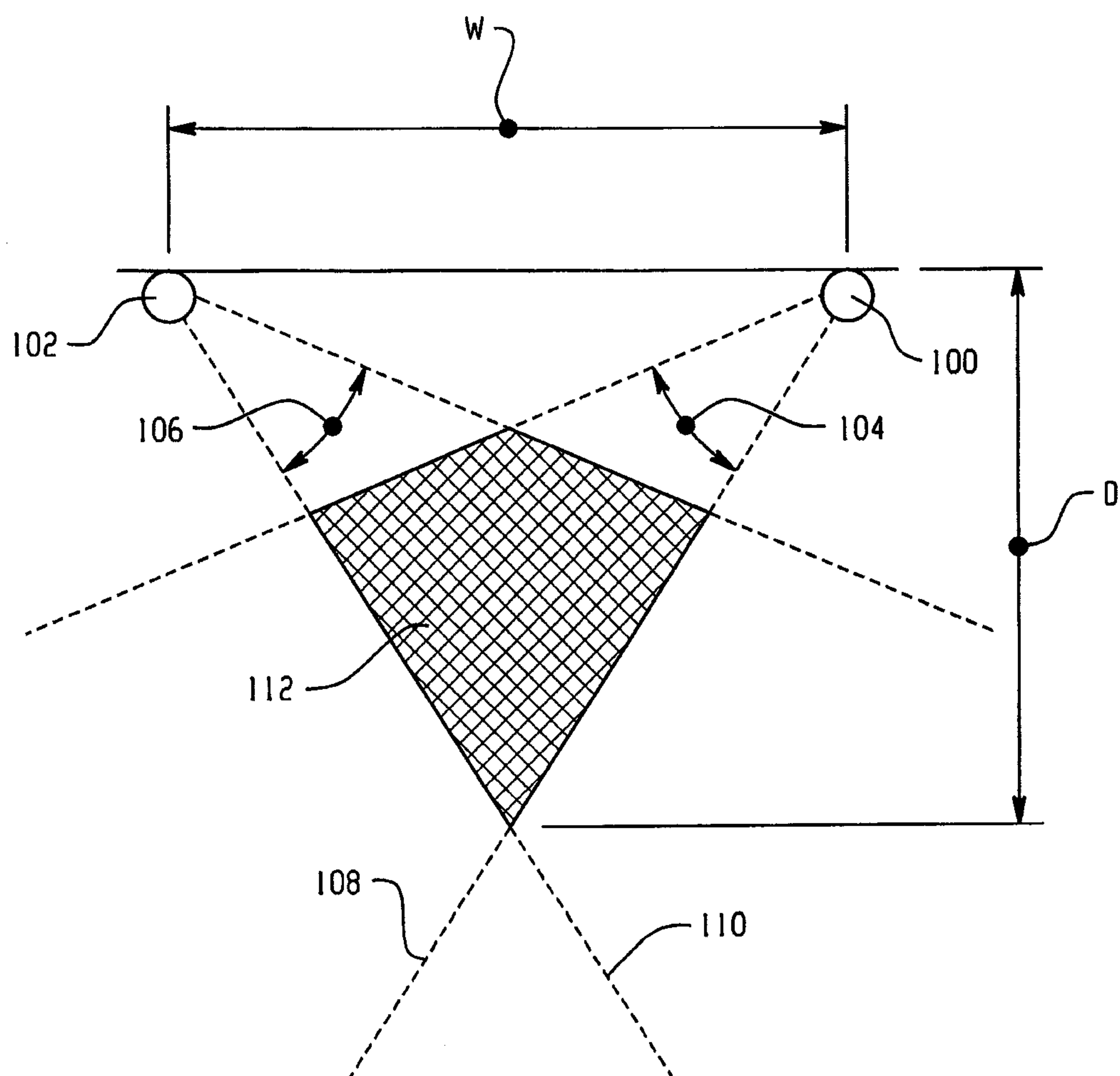


Fig. 10

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*Fig. 11*

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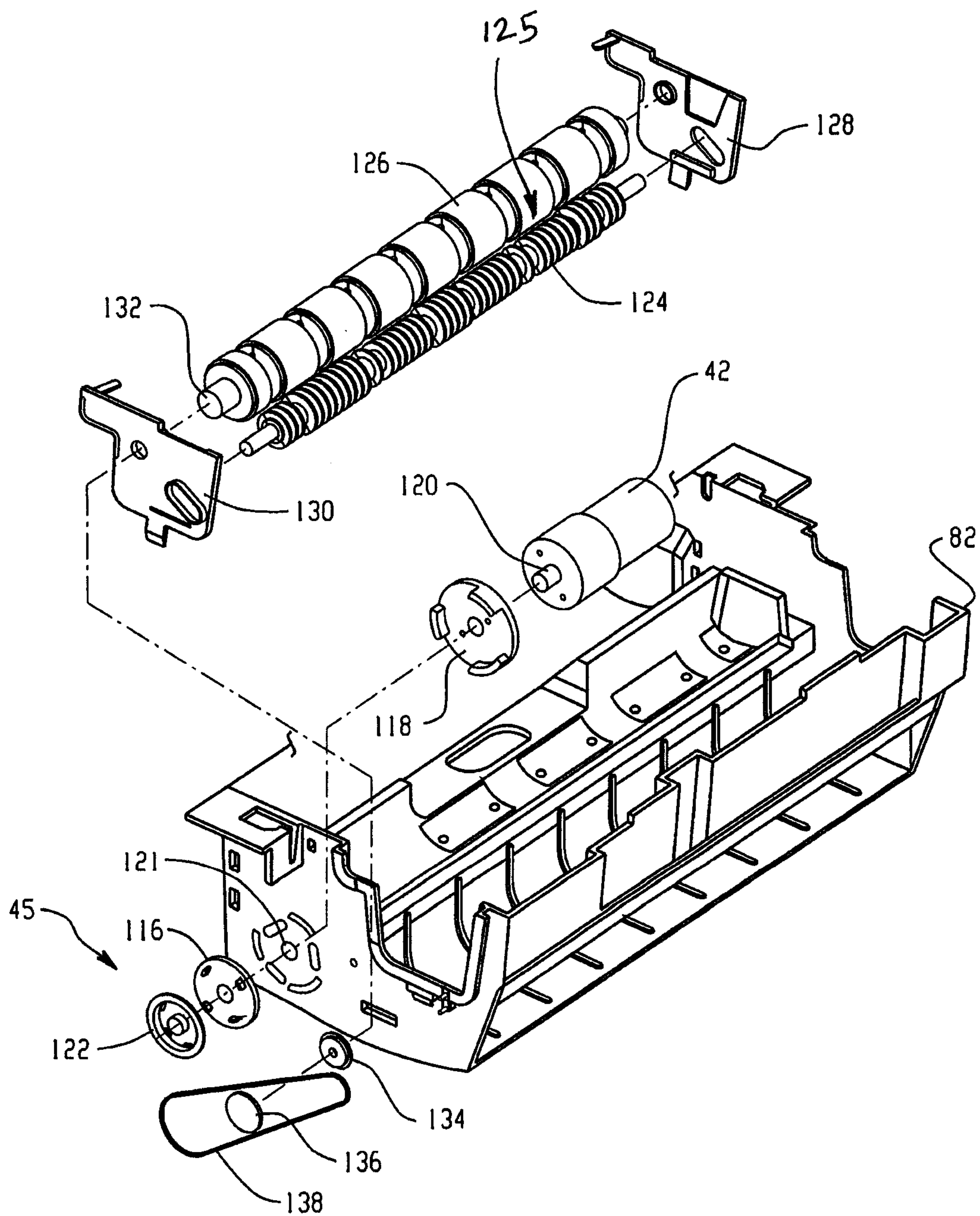
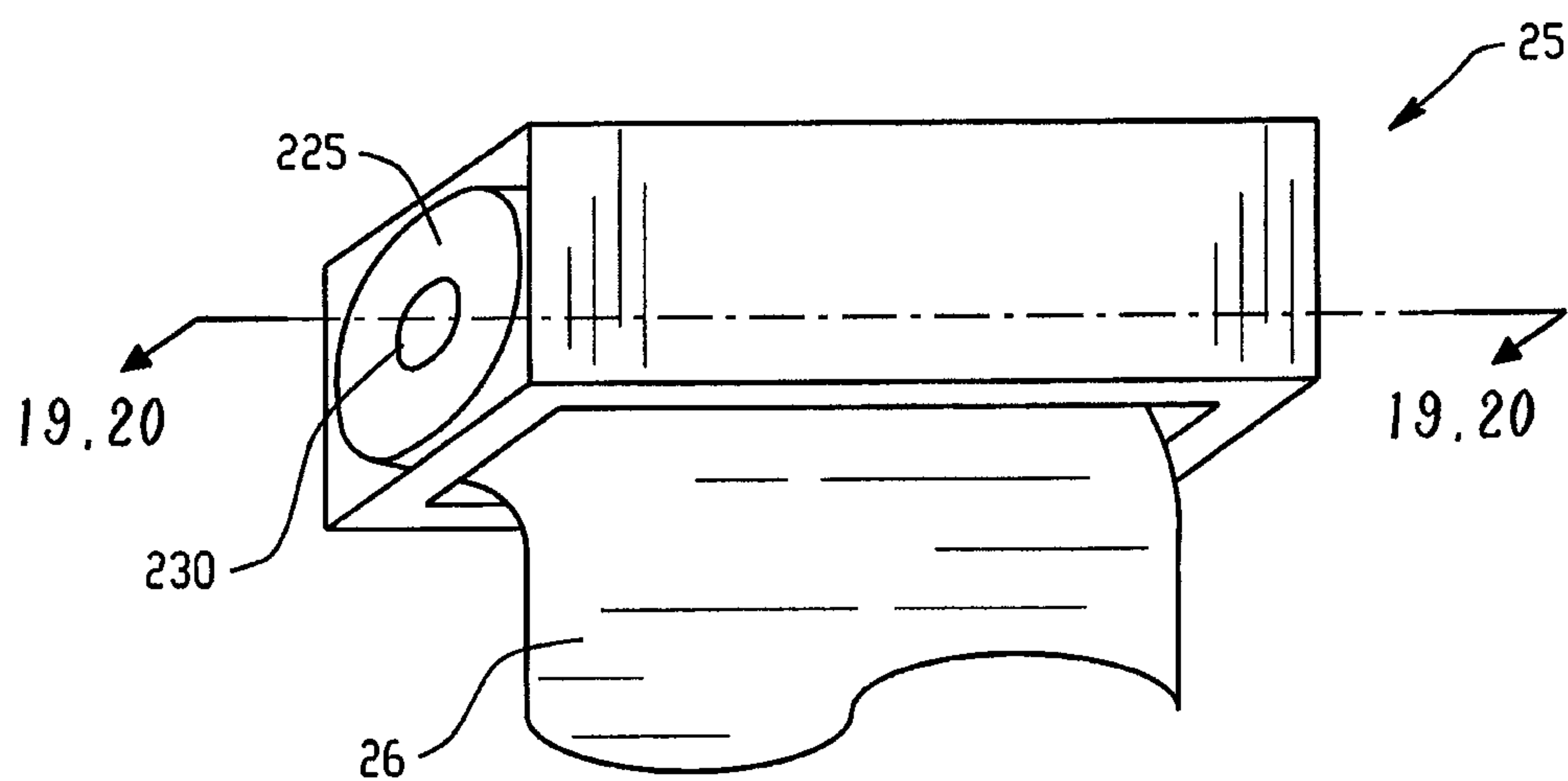
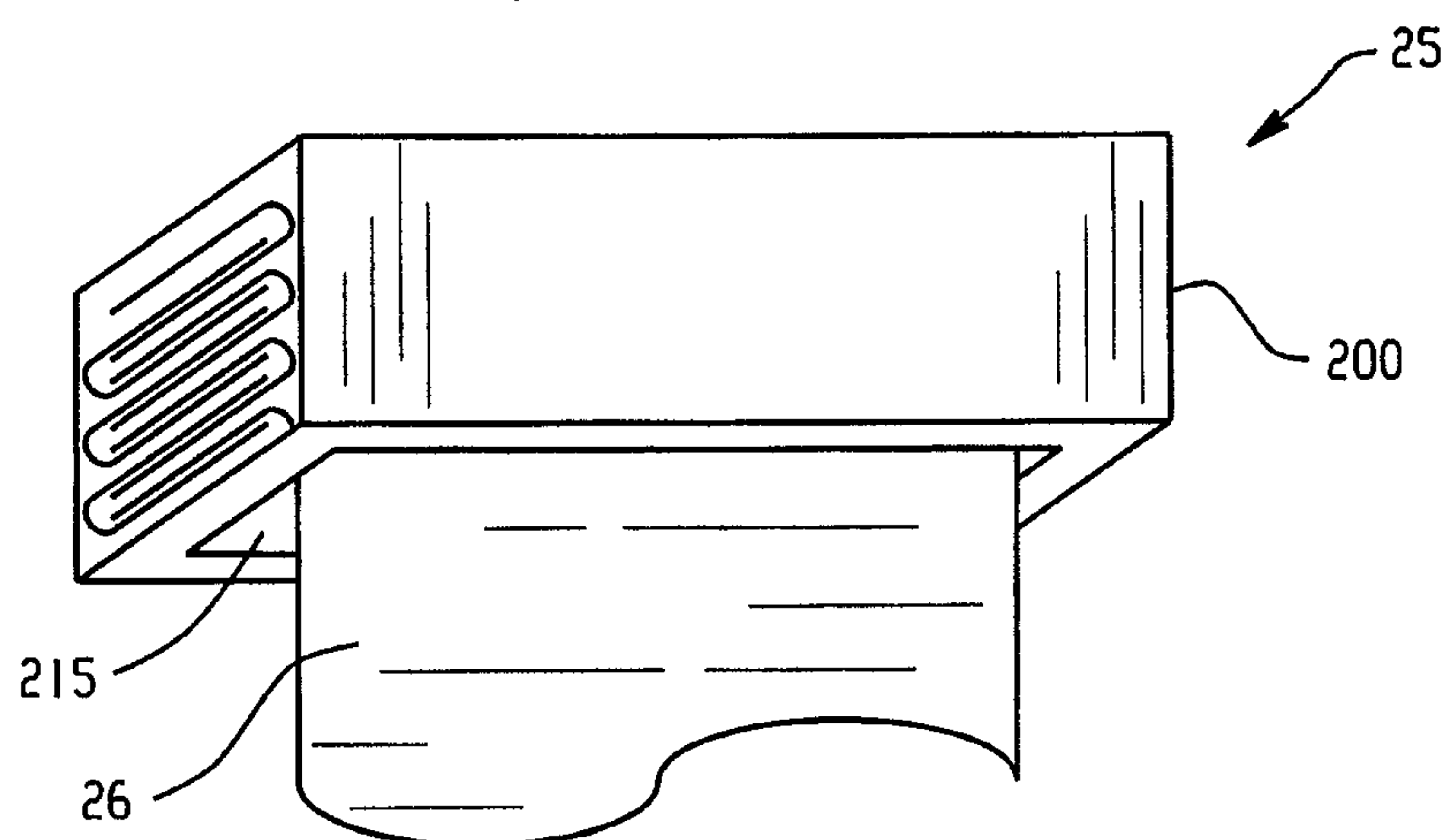
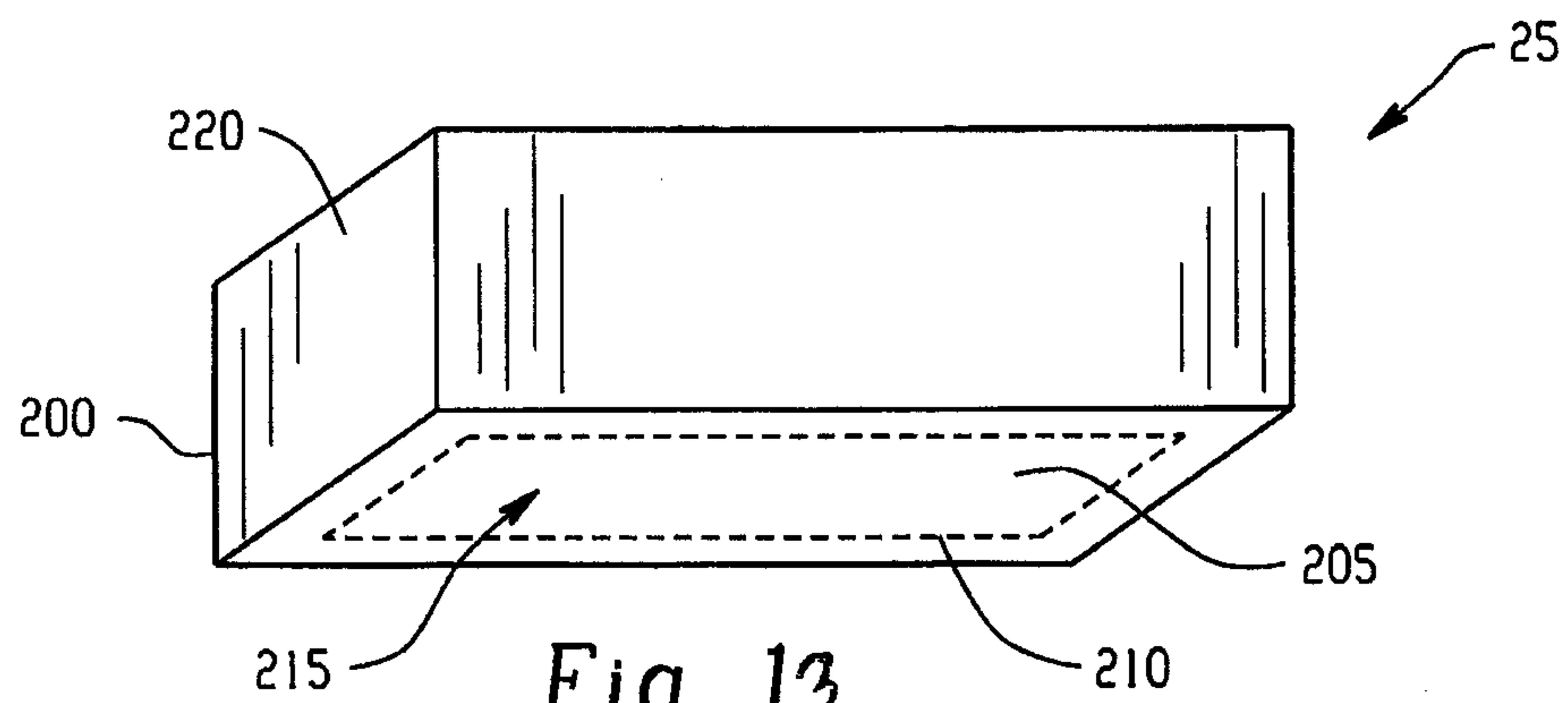


Fig. 12

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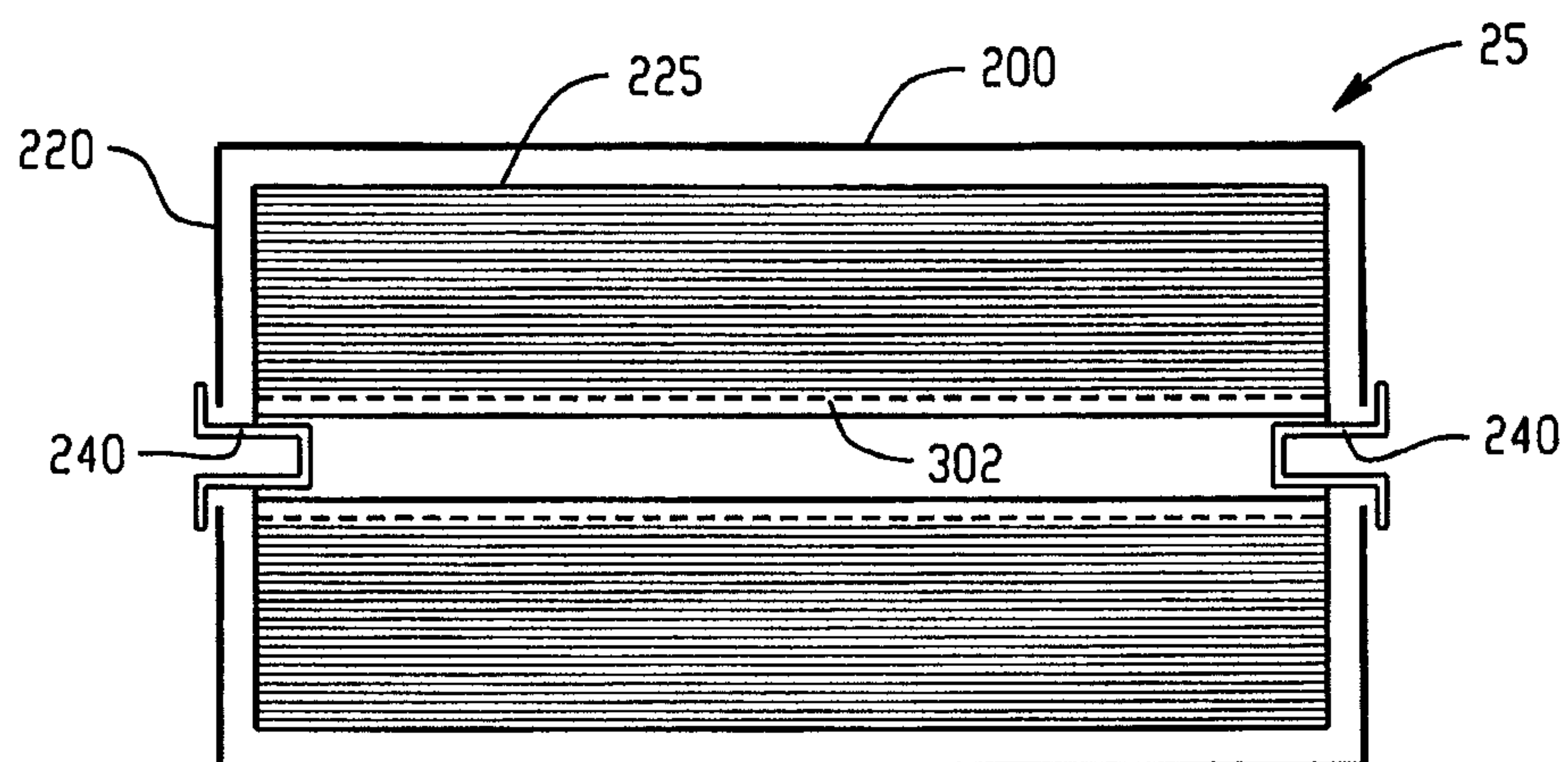


Fig. 16

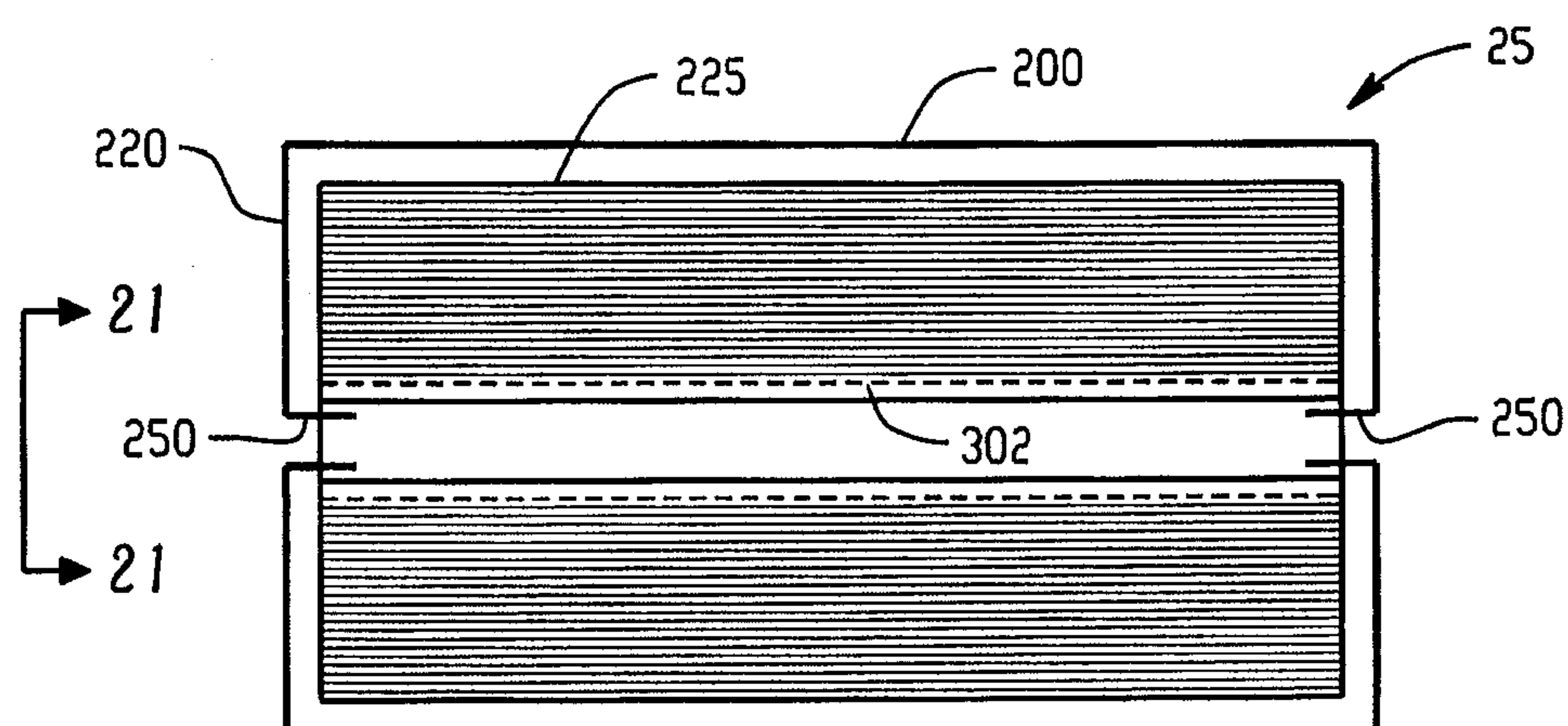


Fig. 17

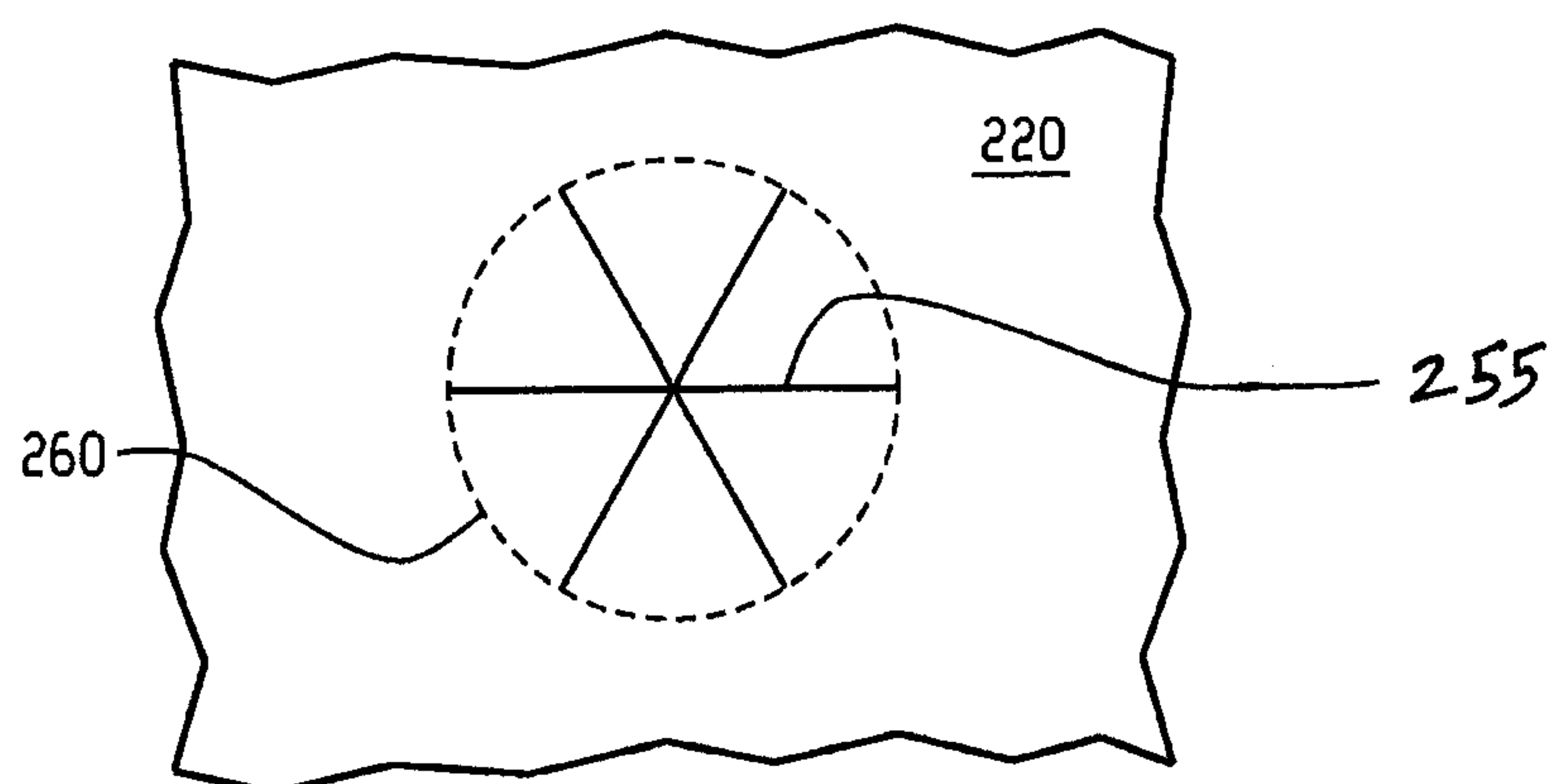
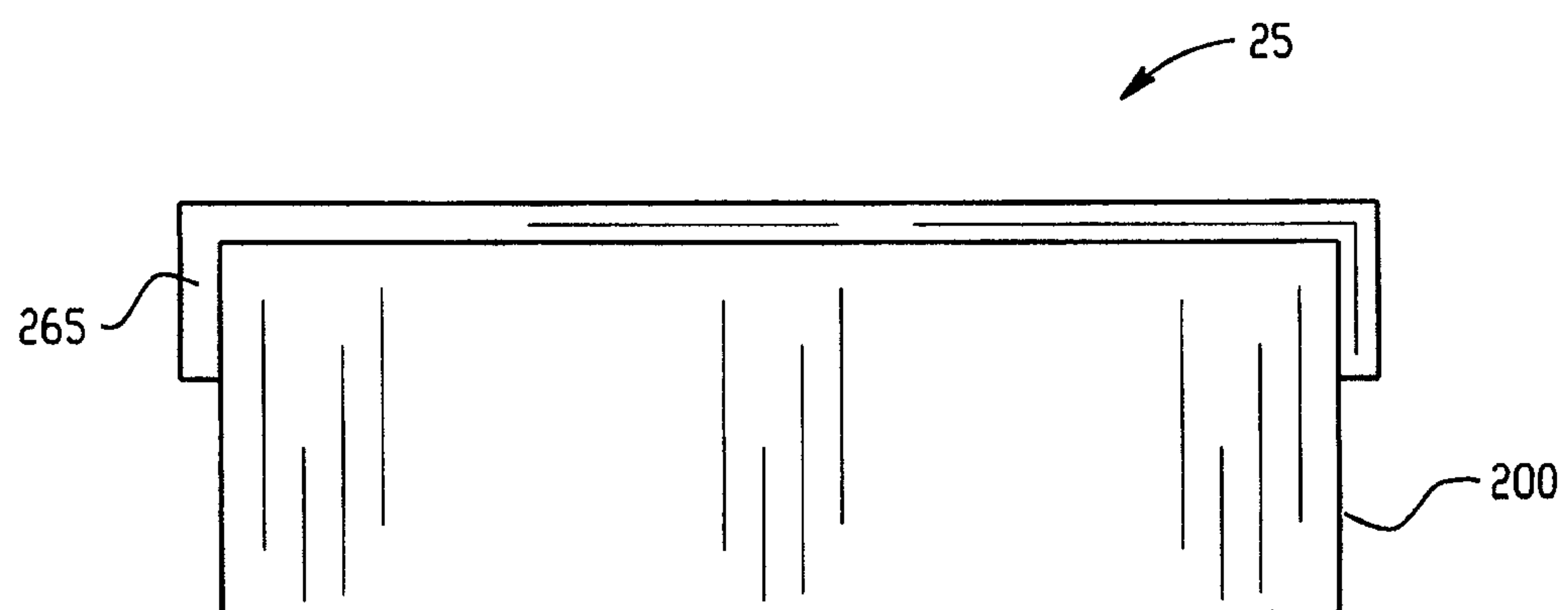
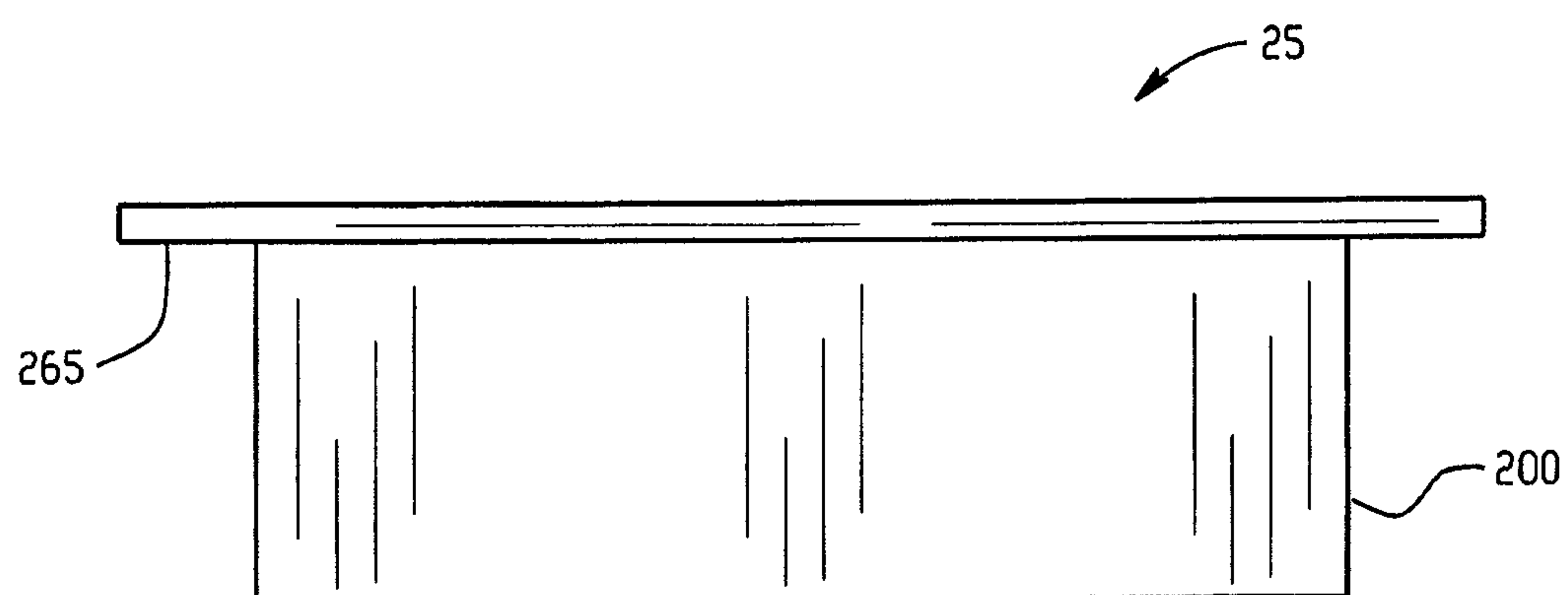
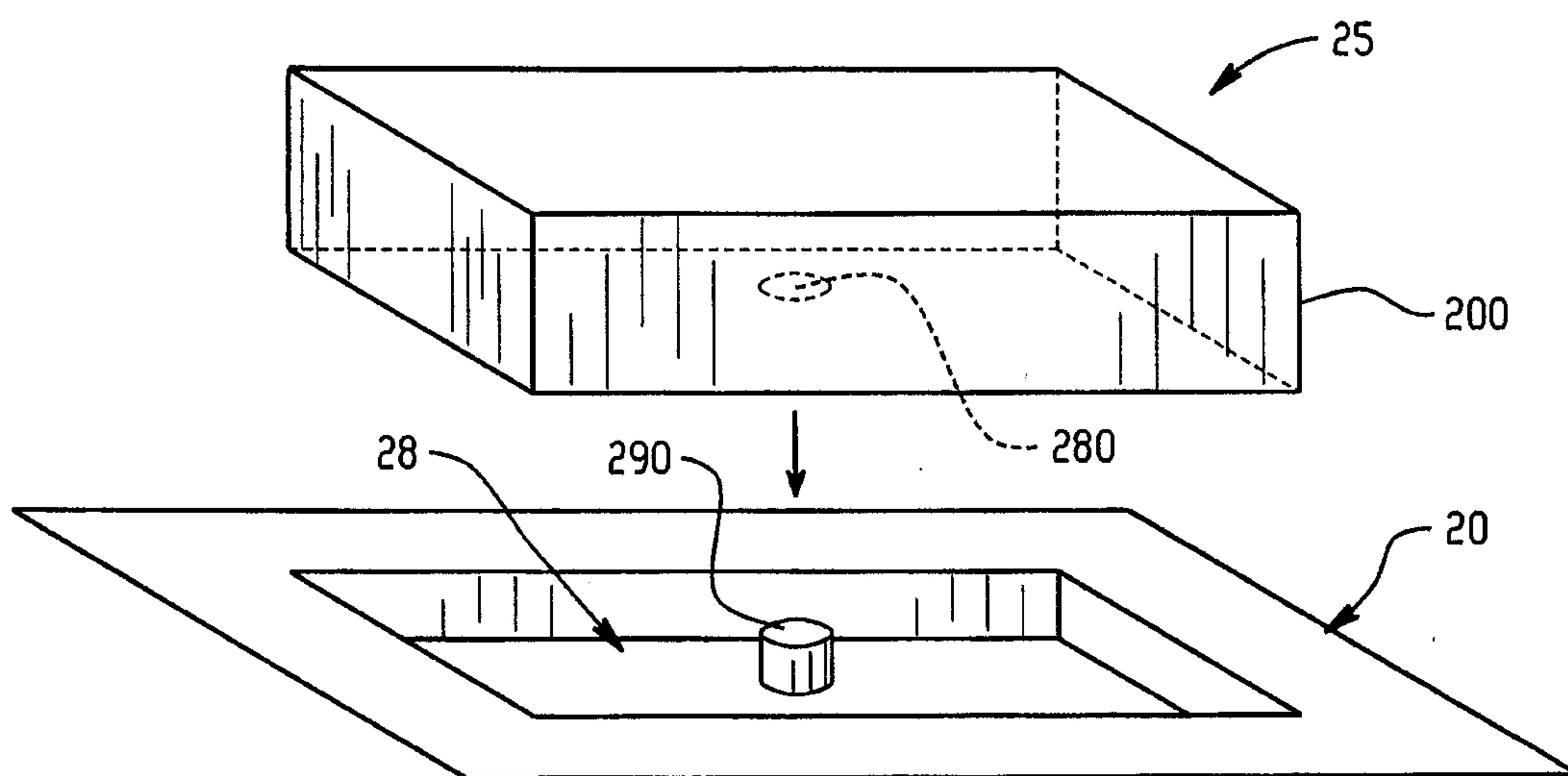
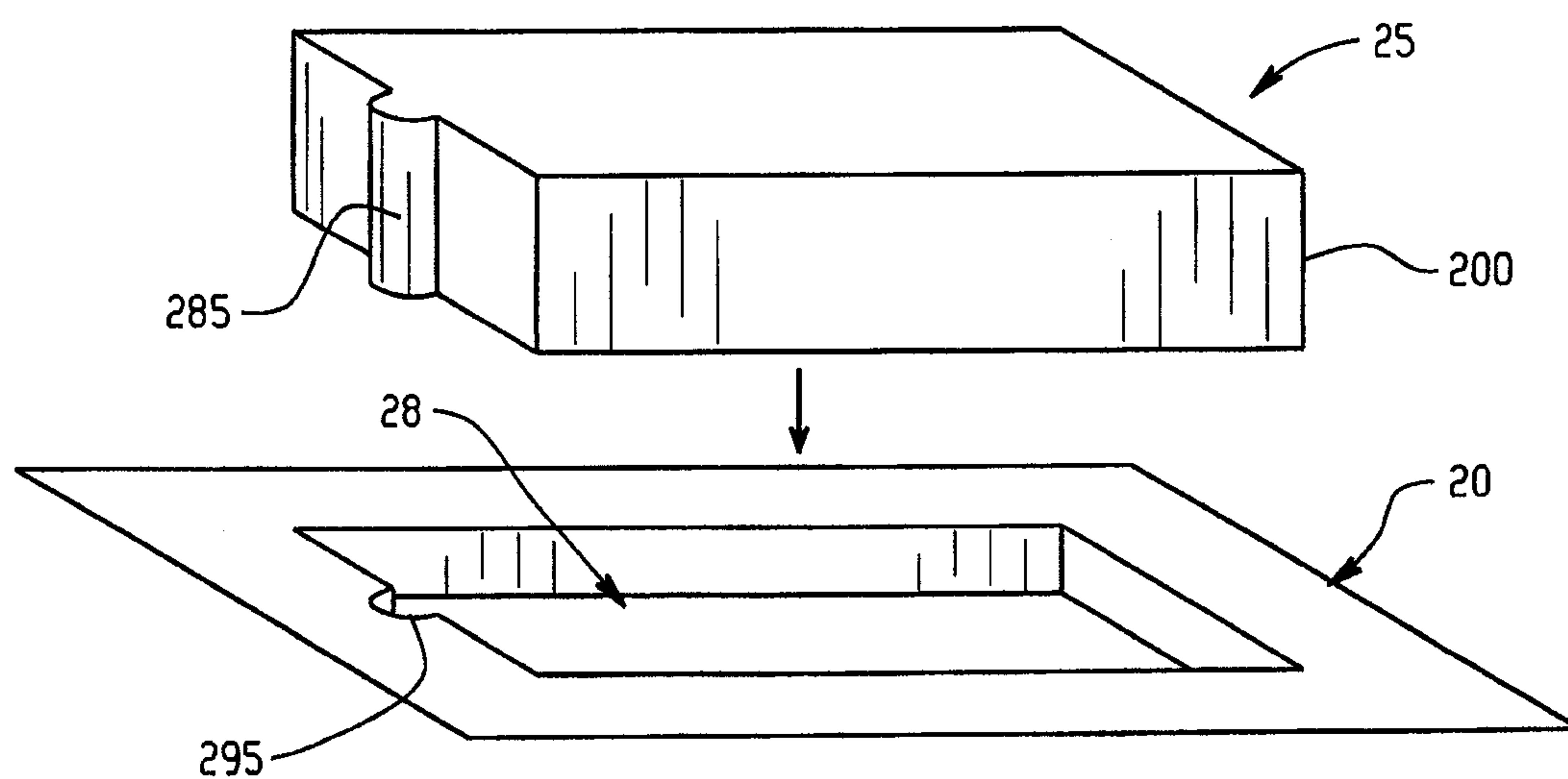


Fig. 18

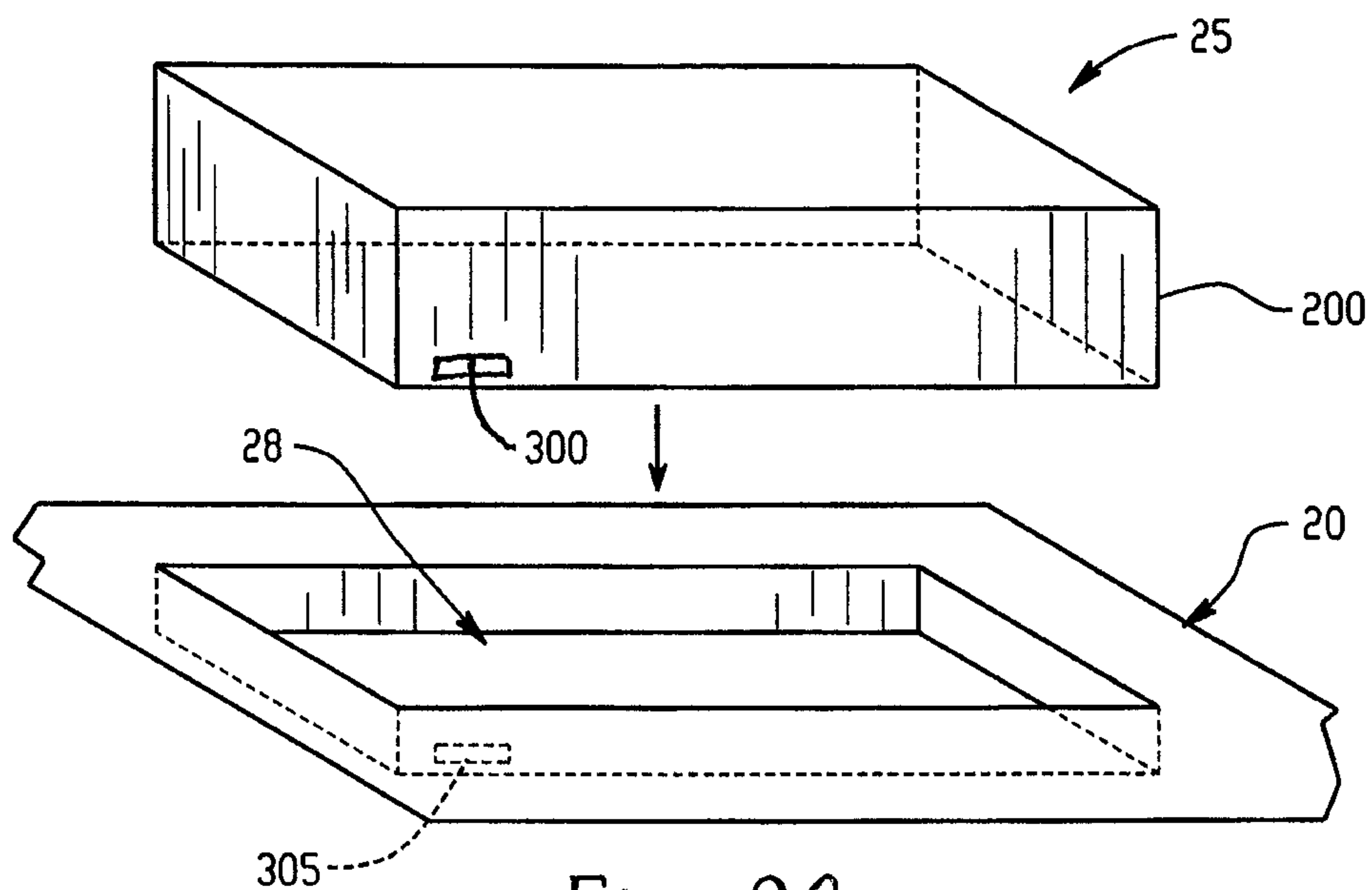
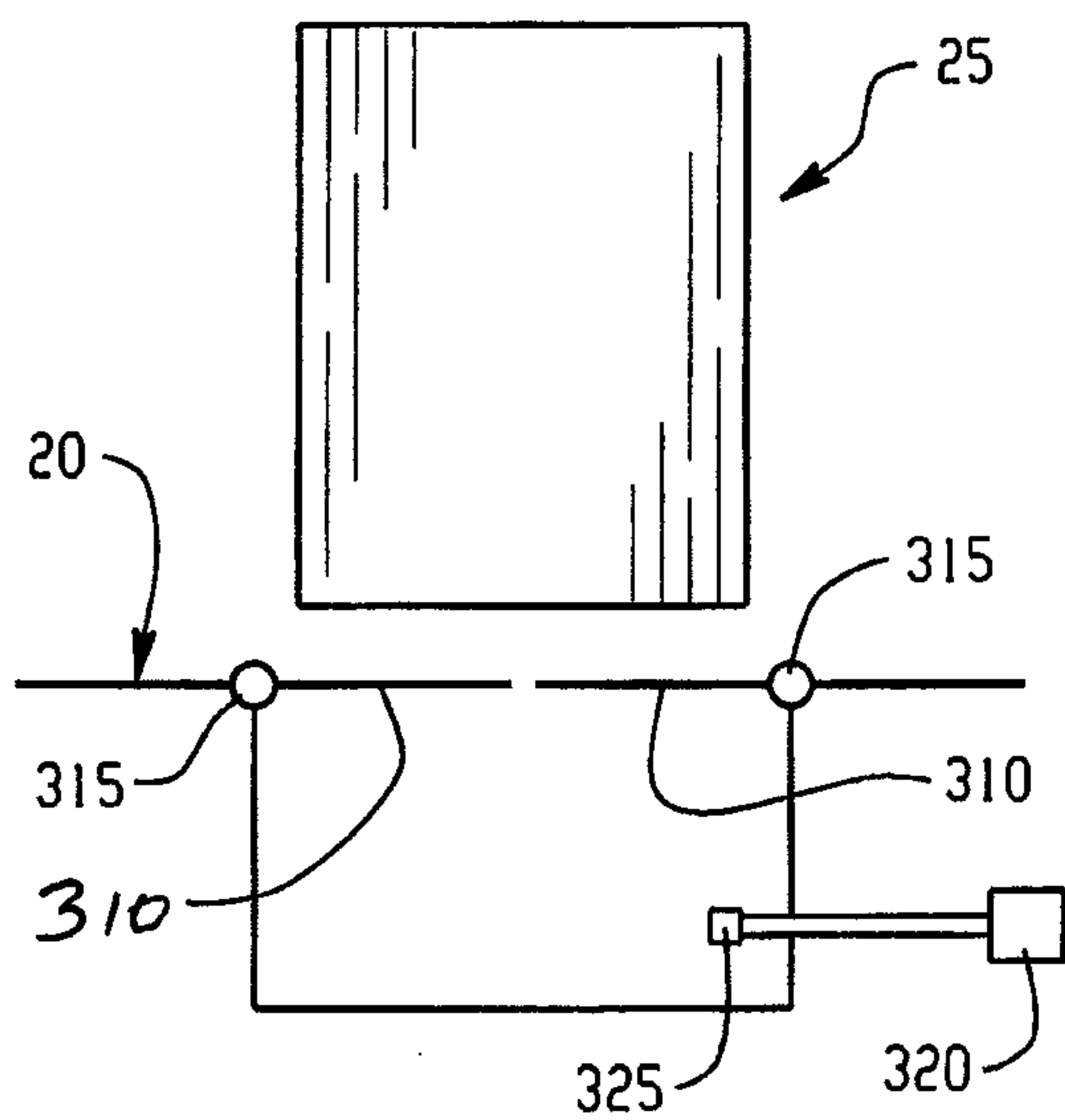
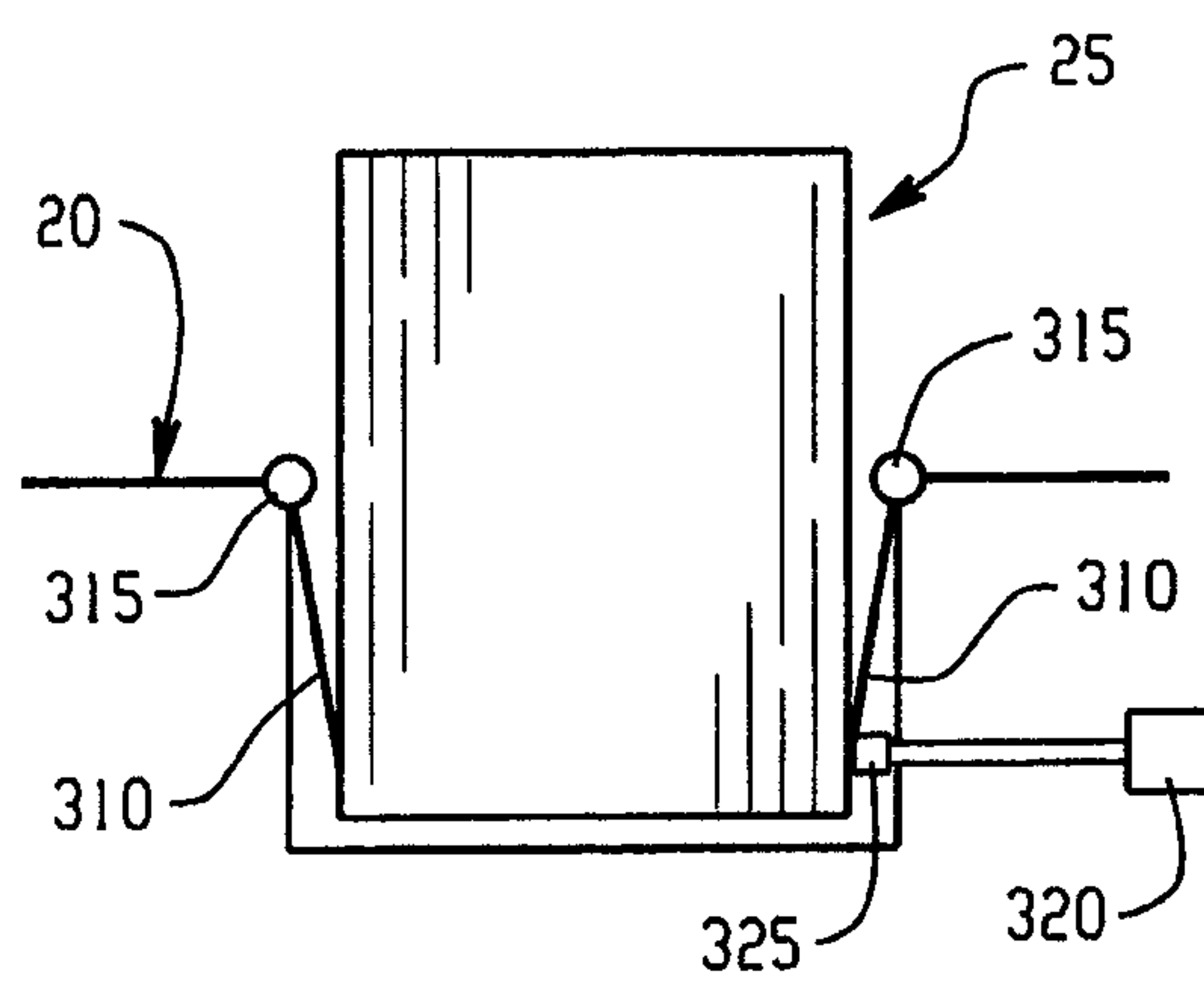
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*Fig. 19**Fig. 20*

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*Fig. 21**Fig. 22*

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*Fig. 23**Fig. 24A**Fig. 24B*

