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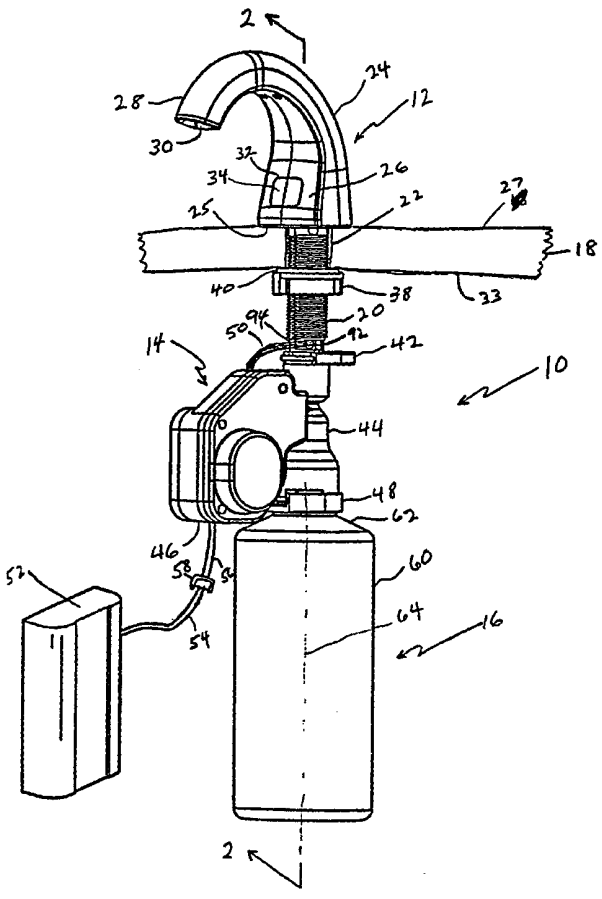
(54) Title: SYSTEM AND METHOD FOR DISPENSING SOAP



(57) Abstract: An automatic fluid soap dispensing apparatus (10) and method comprising a dispensing spout (24), housing (44) operatively connected to the dispensing spout (24) and the housing (44) adapted to removably receive and hold a fluid soap containing reservoir module (60) in communication with the dispensing spout (24). The reservoir module (60) has a central axis (64), and includes a pump mechanism (65) and delivery tube (68) mounted on the reservoir module in alignment with the central axis (64). The dispensing tube (68) is adapted to move in the dispensing spout (24) when the pump mechanism (65) is actuated.

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SYSTEM AND METHOD FOR DISPENSING SOAP

RELATED APPLICATIONS

This application is a non-provisional patent application based on Provisional Serial No. 60/156,987 filed on October 1, 1999.

The present invention relates generally to automatically operated devices for repeatedly dispensing fluid material from a replaceable reservoir, and more particularly to a fluid dispensing apparatus and method which dispenses fluid material automatically in response to sensing the presence of a user.

BACKGROUND OF THE INVENTION

Users of modern public washroom facilities increasingly desire that each of the fixtures in the washroom operate automatically without being touched by the user's hands. This is important in view of increased user awareness of the degree to which germs and bacteria can be transmitted from one person to another in a public washroom environment. Today, it is not uncommon to find public washrooms with automatically, hands-free operated toilet and urinal units, hand washing faucets, soap dispensers, hand dryers and door opening mechanisms. This allows the user to avoid touching any of the fixtures in the facility, and therefore lessen the opportunity for the transmission of disease carrying germs or bacteria resulting from manual contact with the fixtures in the washroom.

It is also required that counter-mounted fluid soap dispensers in public washrooms include a soap reservoir that is readily replaceable when empty, and is inexpensive to manufacture and maintain. Therefore, the soap reservoir must comprise a container that is easy to install in association with the permanent elements of the soap dispensing fixture such that the reservoir container is held fast to the fixture, and can easily be removed from the fixture when empty.

The soap reservoir must also have a fluid soap delivery system which ensures the delivery of a uniform measured dose of fluid soap to a user upon each automatic actuation of the fixture. The reservoir, pump and container must function as a unitary device to deliver consistent measures of fluid soap from the reservoir to the user.

Several automatically operated washroom fluid soap dispensers have been developed, as disclosed in U.S. Patent Nos. 4,967,935 (Celest), 4,938,384 (Pilolla), 4,921,150 (Lagargren), 4,722,372 (Hoffman), and 4,645,094 (Acklin), by way of example. However, these devices do not incorporate structural elements which provide the consistent operation, ease of installation and replaceability and low cost of manufacture as the present invention.

The present invention overcomes these problems in prior countertop fluid soap dispenser fixtures. The disclosed invention provides a fluid soap dispenser assembly which provides a consistent measured amount of fluid soap into the hands of a user through an elongated delivery tube directly connected to a reservoir container and pump assembly, which delivery tube moves axially within a rigid dispensing spout each time the fluid soap dispenser is actuated.

The soap delivery tube and pump assembly are centrally mounted on the top of a fluid soap reservoir container, such that a new delivery tube, pump assembly and fluid soap container are provided upon replacement of an empty soap reservoir assembly with a full soap reservoir assembly. As a result of the centrally disposed location of the elongated delivery tube and pump assembly on the reservoir container, the delivery tube can be readily extended axially through a curved, rigid dispensing spout mounted to the countertop, and the delivery tube can be readily rotated for ease of movement in the dispensing spout when the unitary reservoir container, pump assembly and delivery tube assembly are rotated during installation of a new, full reservoir container.

The pump assembly mounted on the fluid soap reservoir of the present invention also provides a pump actuator mechanism which comprises a laterally extending actuator portion of the pump assembly, which permits the pump assembly and delivery tube to be mounted centrally with respect to the axis of the reservoir container and the soap dispenser fixture elements. The pump activator is controlled by a battery operated drive mechanism, which is activated upon the sensing of the presence of the user's hands adjacent the dispensing spout by a reflective proximity sensor forming part of the soap dispensing fixture mounted above the countertop.

The fluid soap reservoir container of the present invention also provides advantages over fluid soap dispensing systems of the prior art. A standard manufactured pump assembly can be used in the fabrication of the present reservoir module due to the central location of the pump and of the dispensing tube. This permits the reservoir

module to be filled using standard bottle filling equipment found in the facilities of most contract bottle fillers, thus providing a substantial cost savings in the production of soap refill reservoir modules. The central location of the pump assembly and delivery spout on the present reservoir module also permits rapid installation of the reservoir module on the motor housing by a simple rotation of the dispenser module to complete a bayonet-type connection. The novel construction of the reservoir module enables the mass production of a reliable refill unit.

The combination of the present rigid dispensing spout and fluid soap delivery tube moveable inside the spout permits economy of construction not found in prior automatic soap dispensers. The spring in the pump assembly mounted on the container provides the force to return the delivery tube to its start position after a dose of fluid soap has been dispensed. The spout configuration and construction is adapted to provide ease of movement of the delivery tube in the spout, with a minimum of friction produced. The elongated delivery tube of the present invention is rigid enough to withstand hydraulic pressure developed during the dispensing operation, and flexible enough to move substantially frictionless relative to the interior of the dispensing spout.

The motor housing of the present invention mounts to a shank extending through a countertop, such that the housing can be readily rotated away from the underside of the sink bowl, and away from plumbing fixtures. This is a result of the central mounting of the operative components extending from the reservoir module, through the motor housing, to the entrance to the dispensing spout.

The present invention also includes indicators to advise a maintenance operator when the reservoir module is empty of fluid soap after a pre-determined number of electronically metered doses of soap have been dispensed. A separate indicator advises when the system's batteries are low.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation perspective view of the automatic soap dispenser of the present invention, shown mounted in a washroom countertop;

FIG. 2 is a sectional elevation view of the automatic soap dispenser of Fig. 1, taken along line 2-2;

FIG. 3 is an enlarged detail sectional view of the rigid spout and threaded shank portion of the automatic soap dispenser of FIG. 1 and 2;

FIG. 4 is a cross-sectional view of the threaded shank portion of the present invention, taken along line 4-4 in FIG. 2;

FIG. 5 is a front elevation view of the rigid spout and support shaft of the automatic soap dispenser of the present invention;

FIG. 6 is a cross-sectional view of the connection between the support shaft and the motor housing and support assembly, taken along line 6-6 in FIG. 2;

FIG. 7 is a detail section view of the splined connection between the support shaft and motor housing and support assembly of the present invention;

FIG. 8 is a top plan detail view of the clip adapted to removably connect the motor housing and support assembly to the support shaft of the present invention;

FIG. 9 is a cross-sectional view of the clip of FIG. 8, taken along line 9-9;

FIG. 10 is a bottom plan detail view of the clip of FIG. 8;

FIG. 11 is a perspective view of the clip of FIG. 8;

FIG. 12 is a detail section view of the support shaft connected to the motor housing and support assembly of the present invention, showing the mounting clip in an unlocked position, and showing the pump hammer actuator of the present invention;

FIG. 13 is a detail perspective view of the pump hammer of the present invention;

FIG. 13A is a sectional view of the support shaft and motor housing and support assembly taken along line 13-13 of FIG. 12, showing the locking clip in its unlocked position;

FIG. 13B is a sectional view of the support shaft and motor housing and support assembly taken along line 13-13 of FIG. 12, showing the locking clip in its locked position;

FIG. 14 is a detail elevation section view of the pump actuator of the present invention, shown positioned in the pump housing;

FIGS. 15A, 15B and 15C are detail schematic views showing these phases of operation of the pump hammer against the pump actuator flange upon actuation of the pump hammer of the present invention;

FIG. 16 is a cross-sectional view of the pump actuator of the present invention, taken along line 16-16 in Fig. 17;

FIG. 17 is an elevation, partial section view taken along line 17-17 of Fig. 16;

FIG. 18 is a cross-sectional elevation view of the actuator of the present invention, taken along line 18-18 in Fig. 16;

FIG. 19 is a cross-sectional elevation view of the actuator of the present invention, taken along line 19-19 in Fig. 16;

FIG. 20 is a cross-sectional schematic elevation view of the pump mechanism of the present invention;

FIG. 21 is a bottom plan detail view of the mounting clip to removably attach the reservoir module and pump assembly to the motor housing and support assembly of the present invention;

FIG. 22 is a top plan detail view of the mounting clip of Fig. 21;

FIG. 23 is a perspective detail view of the mounting clip of Fig. 23;

FIG. 24 is an assembly elevation of view of the reservoir module and pump assembly of the present invention;

FIG. 25 is a section view of the reservoir module and pump assembly of FIG. 24, taken along line 25-25 of Fig. 24, with the pump mechanism shown only in outline;

FIG. 26 is a section view of the connection between the motor housing and support assembly, and the reservoir module and pump assembly of the present invention, taken along line 26-26 in Fig. 24;

FIG. 27 is a front and top perspective view of the reservoir module and pump assembly of the present invention;

FIG. 28 is a partial section view of the pump actuator mechanism and container neck of the present invention;

FIG. 29 is a partial section view of the electric eye sensor installation of the present invention;

FIG. 30 is a detail front elevation view of the outlet portion of the rigid spout of the present invention;

FIG. 31 is a schematic diagram of an embodiment of the circuit controlling the operation of the automatic soap dispenser of the present invention;

FIG. 32 is a flow chart of an embodiment of the method of dispensing soap of the present invention; and

FIG. 33 is an embodiment of a logic diagram that may be used to implement the soap dispenser circuit shown in Fig. 31.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Referring to Fig. 1, an automatic soap dispenser constructed in accordance with the present invention is generally designated by the numeral 10, comprising three major assemblies: a spout and mounting shaft assembly 12, a motor housing and support assembly 14, and a reservoir module and pump assembly 16. The soap dispenser 10 is shown mounted on a sink countertop 18, with hollow threaded support shaft 20 extending through an aperture 22 extending through countertop 18.

Support shaft 20 is fixed to, or may form a part of, rigid spout 24, which includes a base portion 25 abutting countertop 18, an upwardly extending electronic eye housing portion 26, and a curved dispensing portion 28. In the illustrated embodiment of Fig. 2, a resilient pad 27 is disposed between base 25 of the spout, and the upper surface 29 of countertop 18. The outer end of dispensing portion 28 includes an indented outlet 30 having an opening 31 therein (Fig. 2) through which soap is dispensed, as will be explained. Housing portion 26 includes an opening 32 covered by a transparent lens 34 behind which an electric eye sensor assembly 36 (Fig. 2) is mounted in the housing portion 26, as will be explained. Indicator lights (Fig. 2) are also disposed behind transparent lens 34 to signal a "battery low" and/or soap reservoir "empty" condition. A manually rotatable, internally threaded nut 38 engages the outer threads of shaft 20. When rotated upwardly, nut 38 forces base 25 of rigid spout 24 and pad 27 into tight fitting engagement with countertop 18, to firmly mount spout and shaft assembly 12 to the countertop. A lock washer 40 may be inserted between nut 38 and the underside of countertop 18 to further assure that spout and shaft assembly 12 is firmly mounted to the countertop to avoid movement of the spout.

When automatic soap dispenser 10 is fully assembled, motor housing and support assembly 14 is removably attached to the lower end of support shaft 20 by a shank clip 42, as will be explained with reference to Fig. 8-13. Motor housing and support assembly 14 comprises inter alia, pump housing 44 and motor and actuator mechanism housing 46. Pump housing 44 includes a cylindrically hollow interior 47 (Fig. 2) through which fluid soap is conveyed from reservoir and pump assembly 16 to outlet 30 of spout 24, as will be explained. A reservoir assembly mounting clip 48 is located at the bottom of pump housing 44 to removably mount reservoir and pump assembly 16 to pump housing 44, as will be explained.

Motor and actuator mechanism housing 46 includes a motor 49, gear reduction train 51 and pump hammer 53, which is described in detail with reference to Figs. 2 and 15A, B, C. A connector wire 50 electrically connects the electric eye in housing portion 26 (Fig. 1) to a switch (not shown) controlling the operation of motor 49. also, in the illustrated embodiment, a detached battery pack 52 is electrically connected to motor and actuator mechanism housing 46 through wires 54, 56. Attachment element 58 allows wire 54 to be removably connected to wire 56 during installation of automatic soap dispenser 10. In an alternate embodiment (not shown), battery pack 52 may be permanently or removably attached to motor and actuator mechanism housing 46. In the illustrated embodiment battery pack 52 holds the power supply to drive motor 49 and operate electric eye sensor 36.

The lower portion of pump housing 44 is adapted to releasably hold fluid soap reservoir container 60 to motor housing and support assembly 14. Container 60 includes a top closure 62 having an opening 63 therein through which pump mechanism extends 65 (Fig. 2). In the illustrated embodiment, container 60 is cylindrically shaped around a central axis 64. Opening 63 in container 60 also centered around axis 64. As will be explained, mounting clip 48 is adapted to releasably and securely hold container 60 to pump housing 44.

Referring to Fig. 2, which is a sectional vertical view of the automatic soap dispenser of Fig. 1, rigid spout 24 has a curved internal passageway 66 extending from base 25 through the spout and connecting with opening 30. When reservoir module and pump assembly 16 is attached to motor housing and support assembly 14, as shown in Fig. 2, one end 70 of elongated dispensing tube 68 will move reciprocally in passageway 66 upon actuation of pump mechanism 65. The portion 72 of spout 24 adjacent opening 30 is set back from the tip 74 of spout 24 to provide a shield around the outer end 70 of dispensing tube 68, and to prevent the outer end 70 from being viewed by a user when the end 70 of the dispensing tube extends beyond opening 30.

Electronic eye housing portion 26 of spout 24 is located above base portion 25, and opening 32 in front of housing portion 26 extends in a direction facing opening 30 of spout 24. As will be explained, the individual sensors 501, 502 (Fig. 31) forming electric eye sensor 36 are adapted to detect the presence of a user's hands beneath opening 30, and to activate a switch to initiate operation of automatic dispenser 10, as will be explained. Opening 32 is covered by transparent lens 34.

The surface of internal passageway 66 is composed of a smooth material to provide a substantial frictionless path for movement of elongated dispensing tube 68 in passageway 66, during installation and removal of reservoir module and pump assembly 14, and during each actuation of the automatic soap dispenser 10. In addition, the radius of curvature of internal passage 66 is configured to allow elongated dispensing tube 68 to slidably and smoothly move inside passage 66. By way of example, in the illustrated embodiment, the radius of curvature of passageway 66 is approximately two inches. Dispensing tube 68 is made of LDPE (low density polyethylene), or other suitable material which will not react with the chemicals in the soap, and which provides a smooth outer surface to accommodate almost frictionless movement of tube 68 in passageway 66.

Passageway 66 is centrally disposed in spout 24 throughout the length of the passageway. As seen in Fig. 2, the axis 67 of the lower end of passageway 66 is aligned with central axis 64 of container 60. Thus, when elongated tube 68 and container 60 are rotated during installation of a full container 60, as will be explained, tube 68 rotates in passageway 66 about central axis 67 throughout the length of passageway 66. Since tube 68 is centrally located about axis 64, and is centrally located in passageway 66, container 60 is able to rotate to be properly positioned relative to housing 44 during installation and removal of container 60.

As seen in Figs. 2 and 3, support shaft 20 has external threads 76, and an internal passageway 78 through which elongated dispensing tube 68 extends. Nut 38 includes mating internal threads 77 which engage external threads 76, permitting nut 38 to be rotated and moved upward to engage the underside of countertop 18 and secure support shaft 20 and spout 24 against against movement relative to the countertop. Nut 38 is provided with outwardly extending finger grips 80 to provide facile rotation of nut 38 during installation of automatic soap dispenser 10.

Referring to Figs. 3 and 4, passageway 78 includes a walls 82 and 83 formed inside the hollow portion 84 of support shaft 20. Walls 82 and 83 are held in place at a distance from outer wall 86 of shaft 20 by means of separators 88. External threads 76 are formed in outer wall 86 substantially along the length of support shaft 20. Hollow portion 84 of shaft 20 also includes a channel 90 (Fig. 4) extending the length of shaft 20, and connector wire 50, which extends from electric eye sensor 36 to a clip (not shown) on the end of wire 50, is placed in channel 90. The lower end of wire 50 extends

from an opening 92 (Fig. 1) in a lower portion 94 of shaft 20 beneath threads 76. Passageway 78 is also formed by the end 96 of rib 98 which extends the length of shaft 20 between walls 82 and 83. End 96 of rib 98 is adapted to engage the outer surface of dispensing tube 68 when tube 68 is inserted into or removed from passageway 78, when dispensing tube 68 rotates in passageway 78, and when tube 68 moves reciprocally in passageway 78 when pump mechanism 65 is actuated.

Referring to Figs.5, 6 and 7, extending from the lower portion 94 of shaft 20 is a cylindrical attachment shaft 100 plurality of circumferentially disposed splines 102. In the illustrated embodiment, splines 102 are disposed at thirty degree intervals, for reasons to be explained. Splines 102 are adapted to mate with a plurality of grooves 104 circumferentially disposed in the interior portion 106 of motor housing and support assembly 14 to provide for the attachment of motor housing and support assembly 14 to support shaft 20, whereby the internal passageway 78 of shaft 20 aligns with the central interior portion 106 of motor housing and support assembly 14.

A unique assembly structure including clip 42 provides easy attachment and detachment of motor housing and support assembly 14 to support shaft 20. As seen in Figs. 3 and 5, the lower portion 94 of shaft 20 includes a circumferentially indented groove 108. Clip 42 (Figs. 1, 2, 8-11) is adapted to secure motor housing and support assembly 14 to shaft 20. Clip 42 is generally U-shaped having an opening 110 and a curved closed end 112. As seen in Figs. 9 and 11, clip 42 provides a channel 114 facing inwardly and extending the U-shaped length of clip 42. Sidewalls 116, 118 define channel 114, along with bottom 120. As illustrated in Figs. 8-11, sidewall 116 has a generally greater height than sidewall 118 around the length of U-shaped clip 42, and each sidewall 116, 118 has a specific contour to enable the clip to provide a removable snap fit to engage and hold motor housing and support assembly 14 to shaft 20.

Each inwardly facing portion of sidewall 116 includes a curved first entry radius 121, a generally flat first portion 122 and a generally flat second portion 124 having a first end intersecting first portion 122 at an angle. A second end of second portion 124 is connected to a substantially circular portion 126 which extends beyond 180 degrees, to approximately 240 degrees in the illustrated embodiment along the closed end 112 and to the opposite side of clip 42. circular portion 126 is connected to a generally flat third portion 128, which intersects a generally flat fourth portion 130. At the end of fourth flat portion 130 is a curved second entry radius 132.

Each inwardly facing portion of sidewall 118 of clip 42 includes an entry radius 134, to which is connected a curved first portion 136 terminating in a first nub 138. The nub 138 is connected to a substantially circular portion 140 which extends beyond 180 degrees, to approximately 240 degrees in the illustrated embodiment along the closed end 112 and to the opposite side of clip 42. Circular portion 140 is connected to a second nub 142, which connects to curved portion 144 of sidewall 118. An entry radius 146 is provided at the outer end of sidewall 118.

As can be seen in Figs. 8-11, in the illustrated embodiment, the dimensions and configuration of the inwardly facing surfaces forming the tops of sidewalls 116 and 118 are different. By way of example and not of limitation, in the illustrated embodiment the radius R_1, of circular portion 126 of sidewall 116 is approximately 0.327 inches, and the radius R_2 of the circular portion 140 of sidewall 118 is approximately 0.502 inches. The clip 42 is composed of rigid but flexible material, such that clip 42 is strong enough to hold motor housing and support assembly 14 together with support shaft 20, and yet have sufficient flex in the lateral direction to allow two snap action positions to function properly, as explained below.

Subsequent to mounting spout 24 and support shaft 20 to countertop 18 (Figs. 1,2), the upper interior portion 106 of motor housing and support assembly 14 is moved upwardly into engagement with cylindrical attachment shaft 100 of support shaft 20 until splines 102 mate with groove 104.

A groove 148 circumscribes the outer, upper surface of pump housing 44.

referring to Figs. 12, 13A and 13B, prior to moving motor housing and support assembly 14 into contact with attachment shaft 100, clip 42 is manually and partially mounted on assembly 14 by inserting sidewall 118 into engagement with groove 148. In this first position, entry radius portions 134, 146 are urged initially over the bottom of groove 148, causing clip 42 flex and curved portions 136, 144 to engage the bottom of groove 148 when clip 42 flexes back. The inherent flexibility of clip 42 causes the clip 42 to be somewhat firmly mounted in this first position on the outer upper surface of pump housing 14.

Upon moving motor housing and support assembly 14 into engagement with attachment shaft 100, the circumferential distance between adjacent splines 102 and grooves 104 allows the motor housing and support assembly 14 to be rotated in thirty degree increments, allowing placement of the motor housing and support assembly 14 to

avoid interfering with the underside of the sink bowl, and other plumbing or structural elements located under countertop 18, and allowing the assembly 14 to be positioned for ease of access in case a need to service the unit arises.

When motor housing and support assembly 14 is properly installed on attachment shaft 100, clip 42 is manually moved laterally inward from its first position to a second position in which the sidewalls 116, 118 flex slightly outward, and then inward when circular portion 140 of clip 42 engages the bottom of groove 148 over the full extent of circular portion 140. In the illustrated embodiment of Figs. 8-11, circular portion 140 extends 240 degrees around the bottom of groove 148, which holds the clip removably in place in its second position.

As best viewed in Fig. 12 groove 148 in motor housing and support assembly 14 is partially formed by a flange 150, having an upward facing surface 152. As clip 42 is moved inward, the surfaces 154, 156 of clip 42 (Fig. 9) slide across a portion of upper surface 152 of flange 150, and the underside of flange 150, respectively to slidably engage flange 150 in channel 114 of clip 42 (Fig. 9). As clip 42 is advanced inwardly, sidewall 118 moves into groove 148 as described above, and sidewall 116 moves adjacent groove 108 in support shaft 10 (Fig. 12), until flat portions 124, 128 (Fig. 11) contact the bottom of groove 108. Clip 42 then flexes outward and then inward to allow circular portion 126 of sidewall 116 of clip 42 to engage the top of groove 108 over a distance greater than 180 degrees around groove 108 (Fig. 13B). In the illustrated embodiment, circular portion 126 of sidewall 116 extends approximately 240 degrees around groove 108, although this dimension may vary. With clip 42 in its position shown in Fig. 13B, flange 150 is firmly engaged between surfaces 154 and 156 of sidewalls 116, 118 respectively. Additionally, circular portion 126 of sidewall 116 firmly engages groove 108 in support shaft 20, and circular portion 140 firmly engages groove 148 in motor housing and support assembly 14 with a snap action. Thus, motor housing and support assembly 14 is removably and firmly held to support shaft 20, until clip 14 is manually moved outwardly to disengage the clip from grooves 108 and 148, and from flange 150.

Motor housing and support assembly 14, which includes pump housing 44 and motor and actuator mechanism housing 46, when installed on shaft 20 as described above, provides the driving force for the operation of pump mechanism 65. Referring to Figs. 1 and 2, motor 49 is mounted in housing 46, and is electrically connected to electric

eye sensor 36 through connecting wire 50, and to a source of power contained in battery pack 52 through wires 54, 56 and connector 58. Electric eye sensor 36 acts as a switch to turn motor 49 on, or if desired, sensor 36 could trigger operation of a separate switch (not shown) to activate motor 49.

A reduction gear train 51 mounted for rotation in housing 46 operatively connects the output of motor 49 to pump hammer 53, which is also disclosed in detail in Fig. 14. Referring to Fig. 2, 53 includes an actuate gear portion 158 which meshes with spur gear 160, which in turn is driven by motor 49 through gear reduction train 51. Pump hammer 53 is mounted on pin 162 for rotation through a small arc relative to housing 46. At the end of pump hammer 53 in the illustrated embodiment are a pair of actuator arms 164, 166 which rotate as pump hammer 53 rotates through a small arc. Pump hammer 53 also includes a flat face 168 adapted to engage hammer kick back stop 170, which is rigidly, but adjustably, mounted on the interior of housing 46, as seen in Figs. 1, 12 and 15A-C. The space between actuator arms 164, 166 defines an open space 172 (Fig. 14) for purposes to be explained.

Disposed in the hollow interior of pump housing 47 (Fig. 2) is a generally cylindrical pump actuator 174 (Fig. 14) having an actuator flange 176 extending outward from and circumscribing the body of actuator 174. As seen in Fig. 14, pump actuator 174 engages hollow pump intake tub 178 connected to pump mechanism 65 (fig. 2), and mover downward when pump mechanism 65 is actuated, as will be explained in further detail. The upper movement of actuator 174 is limited by the abutment of top surface 180 of the actuator against inwardly directed limiting surface 182 of pump housing 44, as seen in Fig. 14. Elongated dispensing tube 68 is firmly lodged in cylindrical opening 184 of actuator 174, whereby dispensing tube 68 moves in reciprocal directions along with the movement of actuator 174. Actuator 174 also includes a downwardly extending member 186 adapted to allow passage of fluid soap from the reservoir container 60 through the actuator and into dispensing tube 68, as will be explained in further detail. As shown in Fig. 14, pump housing 44 is provided with an opening 188 in one sidewall to allow selective contact between pump hammer 53 and flange 176 of actuator 174.

Fig. 15A illustrates the condition of pump hammer 53 when the motor 49 is not energized, and pump hammer 53 is in its full kick back position. Actuator arms 164, 166 straddle upper portion 190 of actuator 174, such that upper portion 190 extends into opening 172 between actuator arms 164, 166 as pump hammer pivots clockwise around

pivot pin 162 under the influence of motor 20. In Fig. 15A, actuator arms 164, 166 are disposed a short distance above opposite lateral sides of the upper surface of actuator flange 176.

Upon actuation of motor 49, gear reduction train 51 drives pump hammer 53 clockwise, as viewed in Fig. 15B, until the outer ends of actuator arms 164, 166 initially engage opposing upper surface locations on actuator flange 176. At this point, motor 49 continues to operate, rotating pump hammer 53 further clockwise, and advancing pump actuator downward into pump mechanism 65, as shown in Fig. 15C. The amount of downward movement of pump actuator 174 determines the amount of fluid soap that is dispensed from elongated tube 68 upon each actuation of automatic soap dispenser 10. The distance of downward movement of pump actuator is controlled by the position of hammer kick back stop 170, since flat face 168 of pump hammer 53 abuts kick back stop 170 when a desired dosage of fluid soap is dispensed from tube 68, thus halting further clockwise rotation of pump hammer 53.

Referring to Figs. 15A, B and C, when flat face 168 of pump hammer 53 abuts hammer kick back stop 170, the motor 49 stalls, and the current through the motor increases. The increase in current through the stalled motor is detected by the circuitry (Fig. 31), and the drive to the motor 49 ceases, thus preventing the delivery of tongue by the motor to pump hammer 53. With the motor 49 off, the spring 236 in pump mechanism 65 (Fig. 20) causes the pump chamber 218 to expand, whereby pump actuator 174 moves upward, and flange 176 forces pump hammer 53 to rotate counterclockwise back to its start position. Inertia from gear reduction train carries the counterclockwise rotating pump hammer to the position shown in Fig. 15A.

Figs. 16 and 17 are detail views of the pump actuator 174, showing a beveled form of actuator flange 176, which operates the same as the previously described embodiment. The external body of actuator 174 includes a single circumscribing thread 192, which is adapted to mate with corresponding threads 193 (Fig. 20) in the neck of container 60 to hold actuator 174 and pump mechanism 65 in an inoperative position during shipment of reservoir module and pump assembly 16, as will be explained.

A hollow chamber 194 is provided internally of actuator 174, and a timing shaft 196 extends downward from portion 198 forming the bottom of cylindrical opening 188 (Fig. 14) in which dispensing tube 68 is attached to actuator 174. Tuning shaft 198 comprises four downwardly extending blades 200, which upper portions are attached to

portion 198, with openings 202 between blades 200 to provide for passage of fluid soap material upward along timing shaft 196, through openings 202 and into dispensing tube 68 when pump mechanism 65 is actuated. The bottom of timing shaft 196 comprises a landing 204 adapted to engage sealing upstroke ball cock 206 (Fig. 20) upon actuation of pump mechanism 65.

Referring to Fig. 20 provides a schematic representation of the relationship between pump actuator 174, pump mechanism 65 and fluid soap container 60. for purposes of the present invention, pump mechanism 65 is a standard self priming pump as is known in the art. Pump actuator 174 sits on top of cylindrical walls 208 of pump mechanism 65 and the actuator 174 is secured to pump mechanism at press fit points 210. The interior of pump mechanism 65 includes a substantially V-shaped restriction 212 having an aperture 214 extending therethrough. Ball cock 206 is adapted to rest in the V-shaped trough 216 and block aperture 214 when in the rest position. Beneath restriction 212 in pump mechanism 65 is a cylindrical open outlet chamber 218 having a ridge 220 at the bottom thereof, and an outwardly extending circular wall 222 having outer ends 224 which slidably engage a stationary pump housing 226 form part of pump mechanism 65. The bottom of having 226 is defined by a circular plate 228 having an aperture 230 centrally disposed therein, and a pump ball cock 232 resting in a trough 234 forming the upper portion of aperture 230. Retainer 233 sits atop circular plate 228, and forms a lower mount for spring 236. The upper end of spring 236 abuts ridge 220. When actuator 174 drives pump mechanism 65 downward, spring 236 compresses as fluid soap is pumped out of container 60, and the spring provides the force to return actuator 174 to its upward position upon stall of motor 49, as previously described. The lower end of pump housing 226 includes a cylindrical bass 238 having a hollow central portion 240, into which a hollow soap inlet tube 242 is inserted. Tube 242 extends downward from boss 238 to substantially the bottom of container 60 with a space 244 to allow soap to be conveyed from the bottom of container 60 into tube 242.

Stationary pump housing 226 is firmly attached to neck 246 of container 60 by means of a ferrule 245 which is crimped over outwardly extending flange 250 forming an integral part of pump housing 226. A pump sealing member 252 is firmly secured to pump housing 226 at 254 to prevent fluid soap from leaking out of container 60 during pressurized operation of pump mechanism 65, and during shipment of container 60. Pump sealing member 252 is circular in configuration and has an internal chamber 256

comprising threads 256. Threads 258 are adapted to mate with threads 192 on actuary 174 during shipment of container 60, when pump mechanism 65 is moved downward against the force of spring 236 and is rotated approximately one full turn to engage seal threads 258 with actuator threads 192, and maintain pump mechanism in an inoperative position during shipping. To activate pump mechanism 65 prior to use, actuary 174 is counter, disengaging threads 258 and 192, and pump mechanism 65 moves upward under the force of previously compressed spring 236.

The parent invention also includes a removable fastening assembly including mounting clip 48 (Fig. 1) to enable fluid soap containers 60 to be sequentially installed on and removed from the lower end 260 of motor housing and support assembly 14. Referring to Figs. 2 and 21-23, mounting clip 48 is securely attached to the lower end 260 of assembly 14, and clip 48 includes a centrally disposed opening 262 which aligns with opening 264 (Fig. 15A) at the lower end of assembly 14. A screw, or other suitable fastener (not shown) is inserted through operative 266 (Fig. 21-230 to secure clip 48 onto assembly 14.

As seen in Fig. 23, clip 48 comprises a lower plate 268 which includes opening 264, a wall 270 extending downward from plate 268, and an inwardly extending flange 272. In the illustrated embodiment, clip 48 includes a flat rear wall 274, however the configuration of rear wall 274 may be any other suitable shape. Referring to Figs. 21 and 23, flange 272 includes flat portions 276 on either side of opening 264, nubs 278, and circular portion 280 extending over a distance of approximately 180 degrees. The space between flange 272 and lower plate 268 defines a channel 282, which channel also extends 180 degrees around opening 264, with two flat channel portions extending to rear wall 274. A stop member 284 is disposed in channel 282 for purposes to be explained.

Referring to Figs. 21-23, plate 268 of clip 48 comprises a plurality of inwardly facing protuberances 286 along the rim of opening 262, with spa 288 formed between the protuberances 286. Friction surfaces 290 (Figs. 21, 23) are provided on one or more of the upwardly facing protuberances 286 to cause a friction fit between clip 48 and tabs 292 on container 60 when reservoir module and pump assembly 16 is installed in soap dispenser 10, as will be explained.

Referring to Figs. 24 and 25, clip 48 is illustrated unattached to the lower end 260 of motor housing and support assembly 14, but it is to be understood that clip 48 is

attached to assembly 14 as shown in Fig. 2. As seen in Fig. 27, container 60 includes a neck 246, and tabs 292 external outwardly from neck 246. Each tab 292 has a substantially flat upper and lower surface, dimensional to fit in channel 282 of clip 48, as seen in Fig. 25. The illustrated embodiment of Figs. 24-27 show four equally spaced tabs 292 located around the neck 294 of container 60. However, container 60 may contain a different tab configuration, such as three or two tabs by way of examples, if desired, with corresponding changes in number of protuberances 286 and spaces 288 in clip 48 (Figs. 21, 22).

Fig. 29 is a view of the location of electric eye sensor unit 36 in spout 24, and Fig. 31 is a block diagram view of an embodiment of the soap dispenser circuit of the automatic soap dispenser assembly 10 of the present invention. In Fig. 31, the soap dispenser circuitry 500 includes an infrared (IR) emitter 501, an IR detector 502, an assembly control circuit 503, voltage regulators 504, a voltage source 505, control diodes 506 and speaker 507. In this embodiment, the IR emitter 501 is located in electric eye sensor unit 36 (Fig. 29), and includes a second voltage source 508 to provide a potential to IR emitter 501 in order to emit pulsed IR signals from the soap dispenser assembly 10. As is well known in the industry, the second voltage source 508 may be a potential creating voltage source, such as a battery or other device that creates a voltage potential to initiate a flow of electrons from the second voltage source 508. While the illustrated embodiment provides a potential of 6V being applied to the IR emitter 501, other embodiments may vary the second voltage source 508 so long as IR signals may be pulsed from the IR emitter 501. Also, part of the IR emitter 501 is a standard diode 509, much like control diodes 506, that controls the direction of the flow of charge from the second voltage source 508. Again, the IR emitter 501 is used to provide IR signals from the soap dispenser assembly 10 as a continuous pulse, controlled by the transmission (TX) and reception (RX) control circuit 510, which is part of the assembly control circuit 503. Also outside of the assembly control circuit 503 is the IR detector 502, which is physically located in electric eye sensor unit 36 (Fig. 29). The IR detector 502 is a low current consumption device, also controlled by the TX and RX control circuit 510, that detects when an object, such as a hand upon which soap will be dispensed, is placed in the sensing field (i.e. path) of the IR signals being emitted from the IR emitter 501. It is noted that IR signal emission is well known in the art using standard IR data transmission techniques. The IR detector 502 has, in this embodiment, a standard diode,

511 to control the direction of the flow of charge and an IR detector amplifier 512. The IR detector amplifier 512 amplifies the pulsed signal and transmits that signal to the receiver circuit 513. Only when three continuously received pulse signals are received by the receiver circuit 513 from the IR detector 502 will the receiver circuit 513 transmit a signal to the motor driver 514, which in turn operates the motor 49. It is noted that the signals being transmitted throughout the soap dispensing circuit 503 are transmitted along standard conducting lines formed of conducting materials as is well known to those skilled in the art. Further note that the motor 49 is driven by the motor driver 514 in conjunction with the voltage source 505 and controlled by the conventional transistor 516.

Still in the soap dispensing circuit 503 of Fig. 31, there is a the TX and RX control circuit 510 that controls transmission of IR signals from the IR emitter 501 and reception of the reflected IR signals from the IR detector 502 that are sent to the receiver circuit 513 and controlled by the TX and RX control circuit 510. To control transmission of control signals between the TX and RX control circuit 510 and the IR detector 502, there is a standard transistor 517 electrically connected to a voltage source 518 (e.g 5V). It is noted that the IR detector 502 is electrically connected to a ground 519 to properly control the flow of charge to the IR detector 502. As previously mentioned, in one embodiment, the motor 49 is turned on (and thus soap dispenses) when the receiver circuit 513 receives three (which may be more or less in other embodiments) continuous pulse signals from the IR detector 502. Three pulses allows the sensors to distinguish between an actual user, and other elements accidentally passing in front of emitter 501. When the motor turns on, a signal is transmitted from the motor driver 514 to the memory counter 520 which is a conventional counter well known in the industry. The memory counter is electrically connected to a switch control circuit 521 that controls three switches, in this embodiment, including a test switch 521, a reset switch 522 and a counter switch 523. These switches are conventional switches that are opened and closed to provide discharge of electrical current to ground depending on which operation (e.g. testing, resetting or counting) is needed. Using the switch control circuit 521, and in conjunction with the motor driver 514 and TX and RX control circuit 510, the memory counter 520 keeps track of the number of cycles (i.e. times soap is dispensed) and sends a signal to the LED driver 525 and tone driver 525 when a certain number of cycles have occurred (e.g. 960 or 1200 cycles) so that an indicator light

embedded in electric eye sensor unit 36 and visible through lens 34 (Fig. 29), or alarm (e.g. using speaker 507),may be activated to signal that the soap dispenser assembly must be refilled. Note that the dispenser 10 will continue to operate after the indicator light or alarm have been activated.

Still in FIG. 31, an oscillator circuit 526, a first frequency divider 527, a second frequency divider 528, an LED driver 529 and a battery level selector 530 are all within the assembly control circuit 503. These elements provide the required signal frequency and time for the LED driver 529 and the tone driver 525 to generate the refill indicator and alarm signal. The oscillator circuit 526 produces electrical oscillations to the first frequency divider 527 and is in connection with the TX and RX control circuit 510. The oscillator circuit 526 is a standard electrical oscillator as is well known in the art. The first 527 and second 528 frequency dividers are in electrical connection with the TX and RX control circuit 510 and the tone driver 525 in order to create the required refill indicator and alarm signal. The tone driver 525 drives the speaker 507 to provide audio sounds when the soap dispensing assembly must be refilled. Similarly, the LED driver 529, in connection with the first frequency divider 527, the battery level selector 530 and the tone driver 525, drives the indicator light to signal that the soap refill is needed. Likewise, the battery level selector 530 indicates to the LED driver 529 when the batteries of the assembly must be replaced. The battery level selector is in connection with several resistors 531 that are used to control the amount of voltage arriving at the battery level selector 530. Outside of the circuit 503 are the voltage regulators 504. These regulators 504 are used to control the amount of voltage transmitted to the circuit 503 and are in electrical connection with a standard capacitor and ground to properly regulate the voltage needed by the circuit 503.

In use, the embodiment of the soap dispenser circuitry 500 of Fig. 31 continuously transmits IR signals from the IR emitter 501 outside of the soap dispensing assembly. When an object, such as a hand, comes within the sensing field or path of the IR signals being emitted from the IR emitter 501, the IR detector 502 receives pulses being reflected by the object and sends a signal to the receiver circuit 513. In the illustrated embodiment, when three continuous pulses have been received by the receiver circuit 513, the receiver circuit transmits a signal to the motor driver 514 which in turn activates the motor 49 to dispense the fluid soap. The amount of soap being dispensed is monitored by the memory counter 520, which works in conjunction with the tone driver

to audibly indicate when the soap must be refilled through the speaker 507, or the indicator light as described above.

Fig. 33 is a series of diagram views of an embodiment of the logic used to control and implement the soap dispenser circuit 500 of FIG. 50.

FIG. 32 is a flow chart of an embodiment of the method of dispensing soap of the present invention. In FIG. 32, two flow charts, flow chart A and flow chart B, of the method of dispensing soap are depicted. Flow chart A depicts an embodiment for a method of replacing the soap after the soap has been used by the continuous cycles depicted in flow chart B. Flow chart A begins at step 540 by replacing the bottle 60 containing the soap to be dispensed using the soap dispensing assembly of the present invention. There is no requirement that the bottle be completely full of soap, but only that some soap be present in the bottle in order to be dispensed by the soap dispensing assembly. A reset button is then pushed at step 541 to reset the memory counter 520 of FIG. 31 to zero which is done at step 542. Recall that the memory counter 520 keeps track of the number of cycles (i.e. number of times soap is dispensed) and sends a signal to the tone driver 525 (FIG. 31) when a certain number of cycles have occurred (e.g. 960 or 1200 cycles) so that an indicator light or alarm (e.g. when using speaker 507 of FIG. 31) may be activated to signal that the soap dispenser must be refilled. In step 542, the counter is reset since the bottle at step 540 has been replaced with a full bottle, in one embodiment.

Still in flow chart A, at step 543, a number of priming pump actuations, for example, four, are performed in order to raise the soap from the container or bottle up through the soap dispensing tube 68. Various embodiments may be used to achieve the priming pump actuations. For example, in one embodiment, the self-priming pump mechanism 65 previously described may be run four times to raise the soap from the container to the dispensing tube 68. In alternative embodiments, the dispensing tube 68 may be manually pumped by a user to raise the soap to the tube 68. Alternatively, additional pumps may be added in other embodiments to achieve the number of pumps needed to raise the soap from the container or bottle to the soap dispensing nozzle. Then at step 544, the low bottle LED driven by the LED driver 529 (FIG. 31) is turned off since a new bottle of soap has been replaced at step 540.

Flow chart B of FIG. 32 is a flow chart of an embodiment of the steps of each cycle (i.e. each time soap is dispensed) that occurs when soap is being dispensed. At

step 545, the IR detector 502 (FIG. 31) which begins the soap dispensing at step 546 senses the hand of a user. Each time the soap is dispensed at step 545, a counter, for example, the memory counter 520 of FIG. 31, is incremented in order to keep track of the amount of soap left in the container 68 or bottle. Recall that each bottle or container 68 has approximately 960 or 1200 cycles that are counted and stored so that the indicator lights or alarm may alert a user or owner when the soap is running low or the container 60 is empty. Steps 545-547 are repeated as long as the counter 520 has counted less than 900 cycles, in this embodiment which is depicted by step 548. It is noted that more or less cycles may be counted in alternative embodiments which only require larger or smaller amount of soap to be stored in the reservoir soap dispensing assembly 16. Thus, 900 cycles is only one embodiment of the number of cycles that are counted which may be more or less in alternative embodiments. Once the cycles reach 900 or more, the LED indicator light or alarm is activated at step 549 to indicate to a user or owner that additional soap will be needed. Also, part of the flow chart B is the battery sensor at step 550 that checks to see if the battery level is less than a predetermined voltage level, e.g. 4.85V. If it is, then the LED light or alarm is activated at step 551 to indicate that the battery is low so that the battery may be recharged or replaced. If the battery level is not less than a predetermined voltage level, the soap is dispensed at step 546 without the LED light or alarm being activated. Again, it is noted that the battery voltage level and number of cycles that trigger the LED light or alarm to activate may vary in alternative embodiments, yet fall within the scope of the claims below.

Figs. 24, 25, 27 and 28 illustrate an embodiment of the reservoir module and pump assembly 16 described previously and adapted for use in automatic soap dispenser 10. The soap inlet tube 42, pump mechanism 65 actuator 174 and dispensing tube 68 all form a unitary assembly that is discarded when the container 60 has been emptied of fluid soap. Therefore, a new pump mechanism 65 and tubes 68 and 242 are furnished with each replacement module 16 installed in dispenser 10. In the present invention, to provide ease of installation of module 16, as will be explained, dispensing tube 68, actuator 174, pump mechanism 65 and intake tube 242 are all aligned on a common centerline, show by the numeral 64 in Figs. 2 and 24. Thus, when modules 16 is rotated during installation and removal from motor housing and support assembly 14, all of the elements comprising reservoir module 16 rotate smoothly and substantially frictionless in their respective housings and passageways. This is of particular importance with

regard to the integrity of elongated dispensing tube 68, which follows an actuator path in passageway 66 of spout 24 (Fig. 2). The rotation of reservoir module 16 during installation and removal causes actuately bent tube 68 to rotate about its own axis, shown as 64 in Fig. 5, however since the rotation takes place around tube 68's own axis, the entire tube rotates substantially freely without any significant compressive or tensile stress being applied to the dispensing tube.

Another factor resulting from the single centerline construction of reservoir module 16 is that actuator 174 can be used with a commonly available pump mechanism 65, without the need for any specially constructed or located pump assemblies. This obviously reduces the cost of reservoir module 16. Pump mechanism 65 is a self priming pump which delivers a predetermined dosage of fluid soap from end 70 of dispensing tube 68 (Fig. 3) upon each actuation of the motor 49. Note also that dispensing tube 68 moves reciprocally in spout passageway 66 with each operation of actuator 174, to provide advantages described below in conjunction with the operation of automatic soap dispenser. 10.

The installation of the automatic soap dispenser 10 of the present invention, as viewed in Fig. 2, is initiated by providing an appropriately sized aperture 22 in countertop 18 at a point adjacent the rim of a sink bowl (not shown) in the countertop. Support shaft 20, which is attached to spout and mounting shaft assembly 12 is inserted downward through aperture 32 until resilient pad 27 beneath base portion 25 of spout 24 abuts the upper surface 29 of countertop 18. Nut 38 and lock washer 40 are then installed over lower portion 94 of support shaft 20, with connecting wire 50 extending through the central opening of nut 38 and lock washer 40. Nut 38 and lock washer 40 tightly abut the underside 33 of countertop 18, with spout 24 being previously rotated such that outlet 30 of the spout is directed to the sink bowl.

Motor housing and support assembly 14 is then attached to support shaft 20 by placing interior portion 106 (Figs. 2, 7) of assembly 14 over attachment shaft 100 such that splines 102 and grooves 104 mate along their respective lengths. Prior to this step, sidewall 118 of shank clip 42 is partially inserted into groove 148 on assembly 14, and is held in the position shown in Fig. 12A. When installing assembly 14, motor and actuator mechanism housing 46 may initially abut against the underside of the sink bowl, or interfere with undersink plumbing or other hardware, fixtures or wires. This problem, if it occurs, can be relieved by removing assembly 14 from attachment shaft 100, rotating

assembly 14 whereby motor housing 46 does not interfere with any other elements, and re-insert interior portion 106 of assembly 14 over attachment shaft 100 until the splines 102 and grooves 104 mate again. In the illustrated embodiment, assembly 14 can be rotated in increments of thirty degrees. When assembly 14 is in its appropriate position relative to attachment shaft 20, shank clip 42 is manually pushed inward such that wall 116 is fully inserted into groove 108 on attachment shaft 100 as circular portion 126 (Fig. 11) engages the bottom of groove 108 and securely holds motor housing and support assembly 14 to support shaft 20. In case it becomes necessary to remove assembly 14 from shaft 20, the processes is reversed whereby shank clip 42 is laterally moved out of grooves 108 and 148, releasing assembly 14 from support shaft 20.

After motor housing and support assembly 14 is properly attached to support shaft 20, as described above, wire 50 (Fig. 1) is attached to a socket (not shown) in motor housing 46 which connects wire 50 to motor 49 and the circuitry shown in Figs. 31 and 33 for operation of electric eye sensor unit 36 and motor 49. Also, battery pack 52 (Fig. 2) including an appropriate number of electric batteries, is attached to a cabinet wall, facility wall, or other fixture element (not shown), and wire 54 is connected to wire 56 by means of releasable attachment element 58.

The installation of the fluid soap reservoir and pump assembly into dispenser 10 is initiated by aligning the outer end 70 of dispensing tube 68 with the centrally disposed aperture 296 (Fig. 14) formed where assembly 14 necks inward. The beveled sides 298 of aperture 296 assist in guiding dispensing tube 68 upward through aperture 296. Container 60, with dispensing tube 68, actuator 174 and pump mechanism 65 attached, is moved upward, feeding dispensing tube 68 into passageway 66 of spout 24. Container 60 continues to be moved upward until top surface 180 (Fig. 14) of actuator 174 abuts limiting surface 182 of assembly 14, preventing further upward movement of container 60. At this juncture, dispensing tube 68 is fully inserted in passageway 66 of spout 24, and the tip 70 of the dispensing tube extends out of opening 30 (fig. 2) a short distance, such that tip 70 of dispensing is hidden by tube 68 is not visible to a user by indented portion 72 of dispensing portion 28 of spout 20 (Fig. 30).

As reservoir module and pump assembly 16 is moved upward, tabs 292 on neck 246 (Fig. 27) pass into opening 264 in mounting clip 48, with each tab 292 moving through spaces 288 formed between protuberances 286 until each tab 292 is adjacent groove 282 in clip 48. As upward movement of container 60 is halted, container 60 is

rotated in either direction, compelling tabs 292 to be positioned in groove 282 adjacent protuberances 286. Stop element 284 abuts one of the tabs 292 to control rotation motion of the container 60 friction surfaces on an upward side of some or all of protuberances 286 apply pressure to tabs 292 to hold container 60 and module 16 securely, but removably in proper contact with motor housing and support assembly 14. To remove an empty reservoir module 16 from assembly 14, the container 60 is rotated in an opposite direction from that described above until tabs 292 align with spaces 288 in clip 48. The container is then lowered, withdrawing dispensing tube 68 from passage 66 in spout 24, and withdrawing actuator 174 and pump assembly 65 from motor housing and support assembly 16. A full reservoir module is then installed, as set forth above.

Once properly installed, operation of the automatic soap dispenser 10 is initiated by a user inserting his or her hands under outlet 30 of spout 24. Electric eye sensor 36 detects the presence of the hands, and sends a signal, as previously described, to actuator motor 49. Reduction gear train 51 drives pump hammer 53 in a clockwise direction, as viewed in Fig. 2, whereby actuator arms 162, 164 initially move toward flange 176 of actuator 174 (Fig. 15A), and the upper portion 190 of the actuator falls into open space 172 between actuator arms 164 and 166. The actuator arms 164, 166 engage the upper surface of actuator flange 176 (Fig. 15B) and drive actuator 174 downward, as viewed in Fig. 15C. In the illustrated embodiment, and by way of example only, actuator 174 moves downward a distance of .280 inches. This downward movement of actuator 174 causes elongated dispensing tube 68 to withdraw the same distance into spout 24 and passageway 66. In the illustrated embodiment, the tip 70 of dispensing tube 68 remains outside of opening 30 in spout 24 in the withdrawn position.

As actuator 174 moves downward under the influence of pump hammer 53, a measured dosage of fluid soap is dispensed from tip 70 of elongated dispensing tube 68, even as tube 68 is moving to its withdrawn position. Referring to Fig. 20, pump mechanism 65, in the illustrated embodiment, is a self-priming pump in which the pump mechanism and dispensing tube 48 are filled with fluid soap prior to actuation of the pump mechanism. As actuator 174 moves downward, pump mechanism 65 forces upward the fluid soap in the pump mechanism, and compresses spring 236. Ball cocks 206 and 232 move upward, causing additional fluid soap to be advanced through inlet tube 242, past ball cock 232, and into chamber 218. Ball cock 206 rises up, but its upward movement is limited when ball cock 206 abuts landing 204 of timing shaft 196.

As pump hammer 53 reaches its limit of clockwise rotation, the motor 49 stalls, and spring 236 (Fig. 20) forces pump mechanism 65, actuator 174 and dispensing tube 68 in an upward direction, causing fluid soap to fill the interior of pump mechanism 65 and dispensing tube 68. Ball cock 206 moves to its closed position over aperture 214. The time ball cock 206 takes to move from landing 204 to V-shaped trough 216 determines the amount of soap dispensed in a single actuation of pump mechanism 65.

Referring to Fig. 18, when soap is being dispensed by pump mechanism 65, fluid soap passes through openings 202 and around timing shaft 196 in actuator 174.

Upon actuation of pump mechanism 65, fluid soap is dispensed from end 70 of tube 68 in a continuos stream as the tube 68 is retracted toward the spout 24. When the motor 49 stalls, as described above, spring 236 (Fig. 20), which was compressed during soap delivery, causes pump chamber 218 to expand as the dispensing tube 68 returns back out of outlet 30 in the spout 24. The combination of the expansion of pump chamber 218 and the forward motion of the dispensing tube causes the fluid soap exiting the tip 70 to be sucked back in at the return of tube 68. This catches a string of soap in the tube 68 which would otherwise drip down after the main soap delivery function. This mode of operation also prevents dripping and residue buildup between uses and cleanings of the soap dispenser.

The foregoing description of illustrated embodiment of the invention has been presented for purposes of description, and is not intended to be exhaustive or to limit the invention to the precise form disclosed. The description was selected to best explain the principles of the invention and practical application of these principals to enable others skilled in the art to best utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention not be limited to specification, but be defined by the claims set forth below.

WHAT IS CLAIMED IS:

1. A reservoir module for an automatic dispensing system comprising:

a container adapted to hold fluid material to be dispensed by the dispensing system, said container having a central axis and a top portion;

an aperture in the top portion of the container, said aperture located on the central axis of the container;

a fluid pump mechanism mounted on said top portion of said container and disposed in alignment with said aperture; and

a delivery tube attached to an upper portion of said fluid pump mechanism, said delivery tube disposed in alignment with the central axis of the container.

2. The reservoir module of claim 1 wherein said delivery tube is elongated.

3. The reservoir of claim 1 wherein said fluid pump mechanism includes an actuator having a flange, said flange disposed off center relative to said central axis of the container.

4. The reservoir module of claim 1 wherein said fluid pump mechanism includes an actuator which dispenses said fluid material from said container through said pump mechanism to said delivery tube upon actuation of said pump mechanism by said actuator.

5. The reservoir module of claim 2 wherein said actuator includes a spider element permitting fluid material to be advanced from said pump mechanism through a central portion of said actuator and to said centrally disposed delivery tube upon actuation of said actuator.

6. A dispensing mechanism for fluid material comprising:

a dispensing spout;

a housing operatively connected to said dispensing spout;

said housing adapted to removably receive and hold a reservoir module in communication with said dispensing spout;

said reservoir module having a central axis,

a pump mechanism and delivery tube mounted on said reservoir module in alignment with said central axis.

7. The dispensing mechanism of claim 6 wherein said delivery tube is disposed in said dispensing spout when said reservoir module is held by said housing.

8. The dispensing mechanism of claim 7 wherein said pump mechanism includes an actuator for selectively activating said pump mechanism,

said delivery tube moving an incremental amount from a first position to a second position when said pump mechanism is actuated.

9. The dispensing mechanism of claim 8 wherein said pump mechanism includes a biasing element to return said delivery tube to said first position in said dispensing spout upon completion of the actuation of said pump mechanism.

10. The dispensing mechanism of claim 6 wherein said housing includes at least one horizontally and circumferentially disposed internal groove at a lower end of said housing, a first opening disposed adjacent said internal groove;

said reservoir module comprising a centrally disposed second opening in a top portion of said reservoir module, said second opening disposed in said first opening when said reservoir module is held by said housing.

11. The dispensing mechanism of claim 10 wherein said reservoir module includes a neck portion adjacent said second opening;

at least one flange element extending outwardly from said neck portion;

said at least one flange extending into said at least one groove of said housing to releasably hold said reservoir module to said housing.

12. The dispensing mechanism of claim 11 wherein said internal groove in said housing includes at least one downwardly extending slot through which said at least one flange moves when installing or removing said reservoir module relative to said housing.

13. The dispensing mechanism of claim 6 wherein said delivery tube is extended into said dispensing spout when said reservoir module is installed in said housing, and said delivery tube is withdrawn from said dispensing spout when said reservoir module is removed from said housing.

14. The dispensing mechanism of claim 6 wherein said reservoir module includes an actuator flange operatively connected to said pump mechanism to selectively actuate said pump mechanism;

said housing includes a drive mechanism operatively connected to said pump mechanism actuator, said drive mechanism moving said pump mechanism actuator upon the detection of the presence of a user of the dispensing mechanism.

15. the method of dispensing fluid soap from an automatic soap dispenser having a spout, a dispensing tube movably disposed in said spout, and a fluid soap container having a pump mechanism attached to said dispensing tube, the method comprising the steps of:

a) sensing the hands of a user;

b) activating the pump mechanism upon sensing the hands to expel fluid soap from the dispensing tube;

c) moving the dispensing tube in a first direction relative to the spout upon activating the pump mechanism; and

d) moving the dispensing tube in a second direction relative to the spout upon completion of the step of activating the pump mechanism.

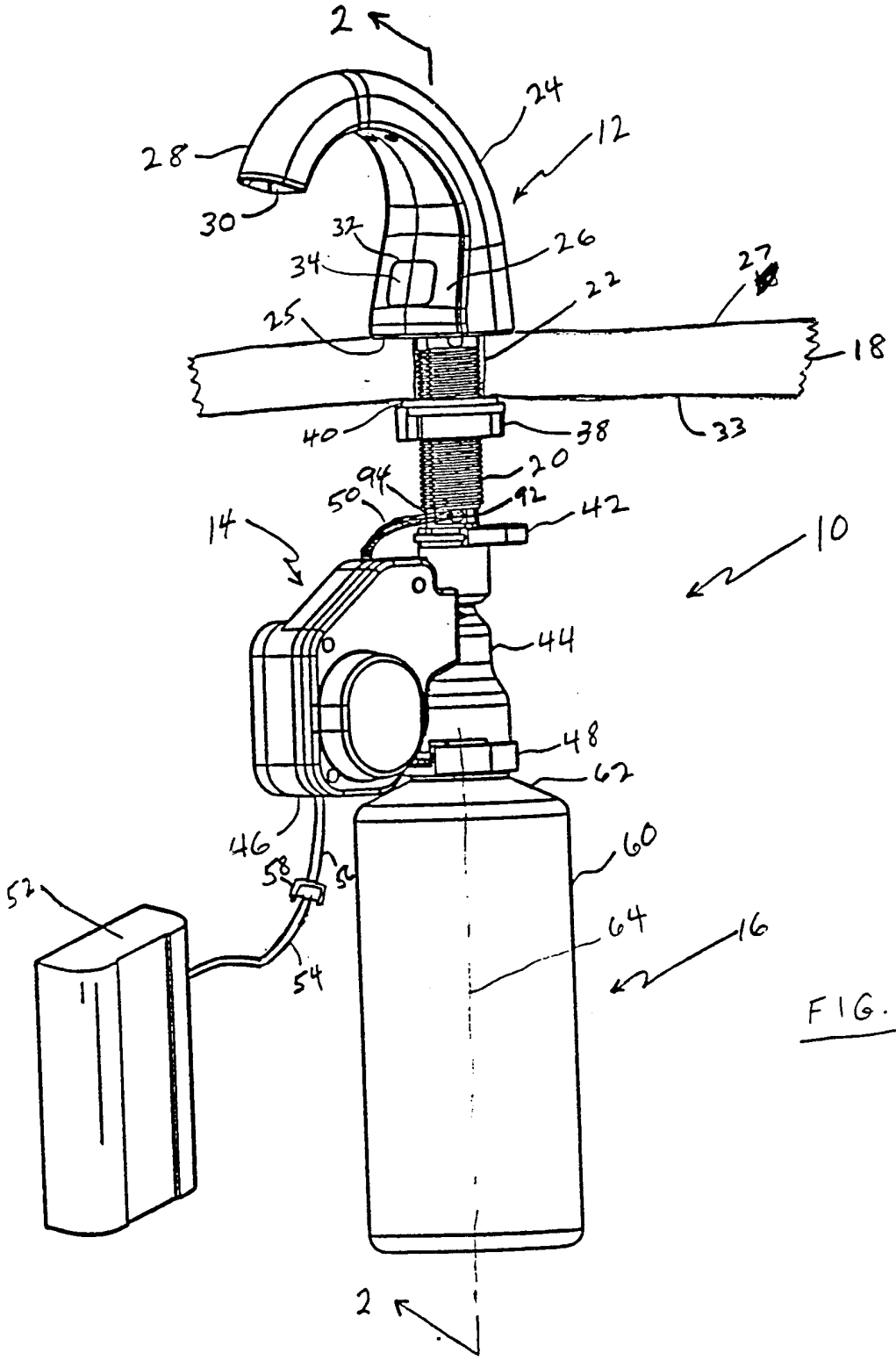
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FIG. 1

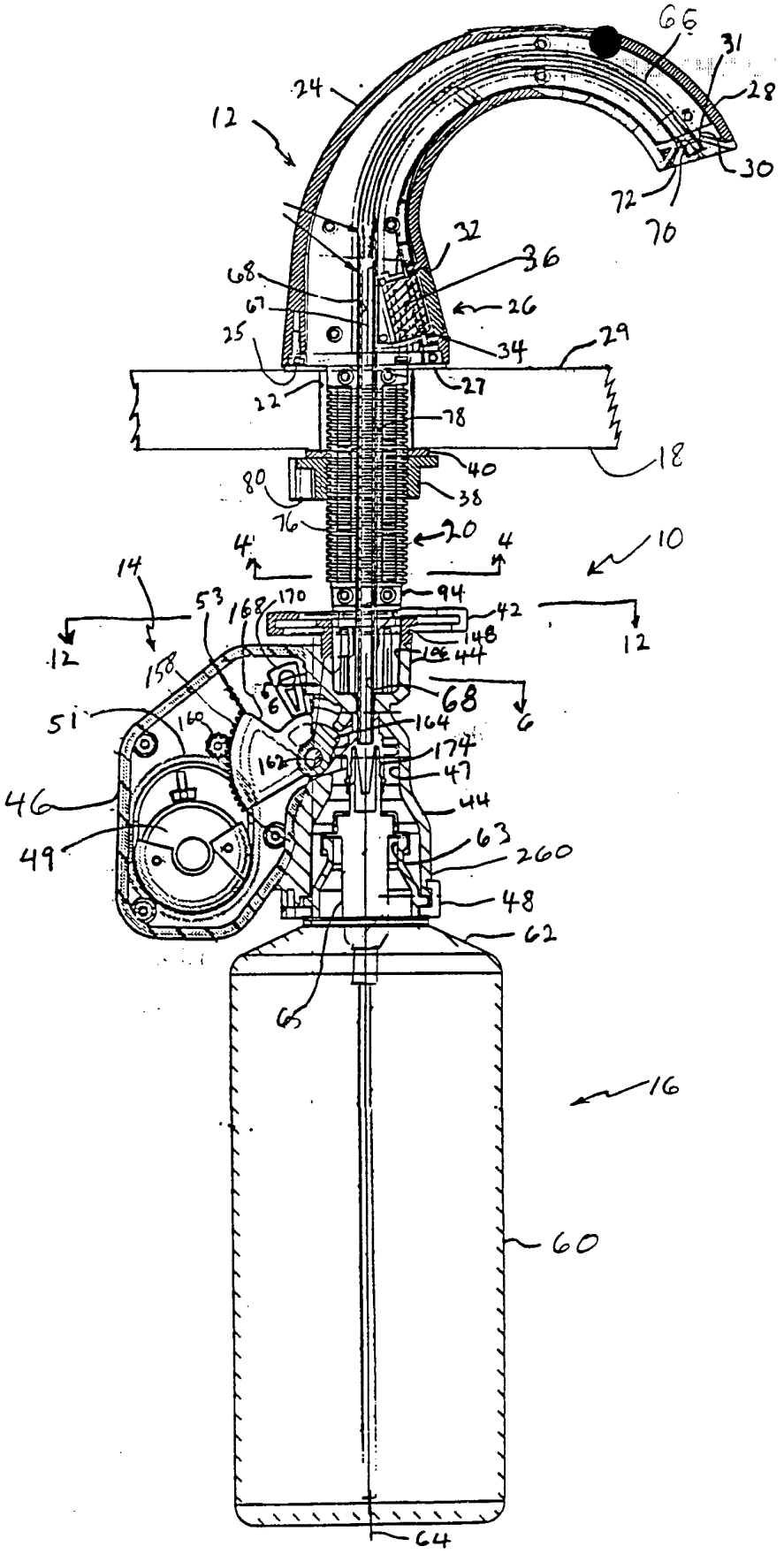
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FIG. 2

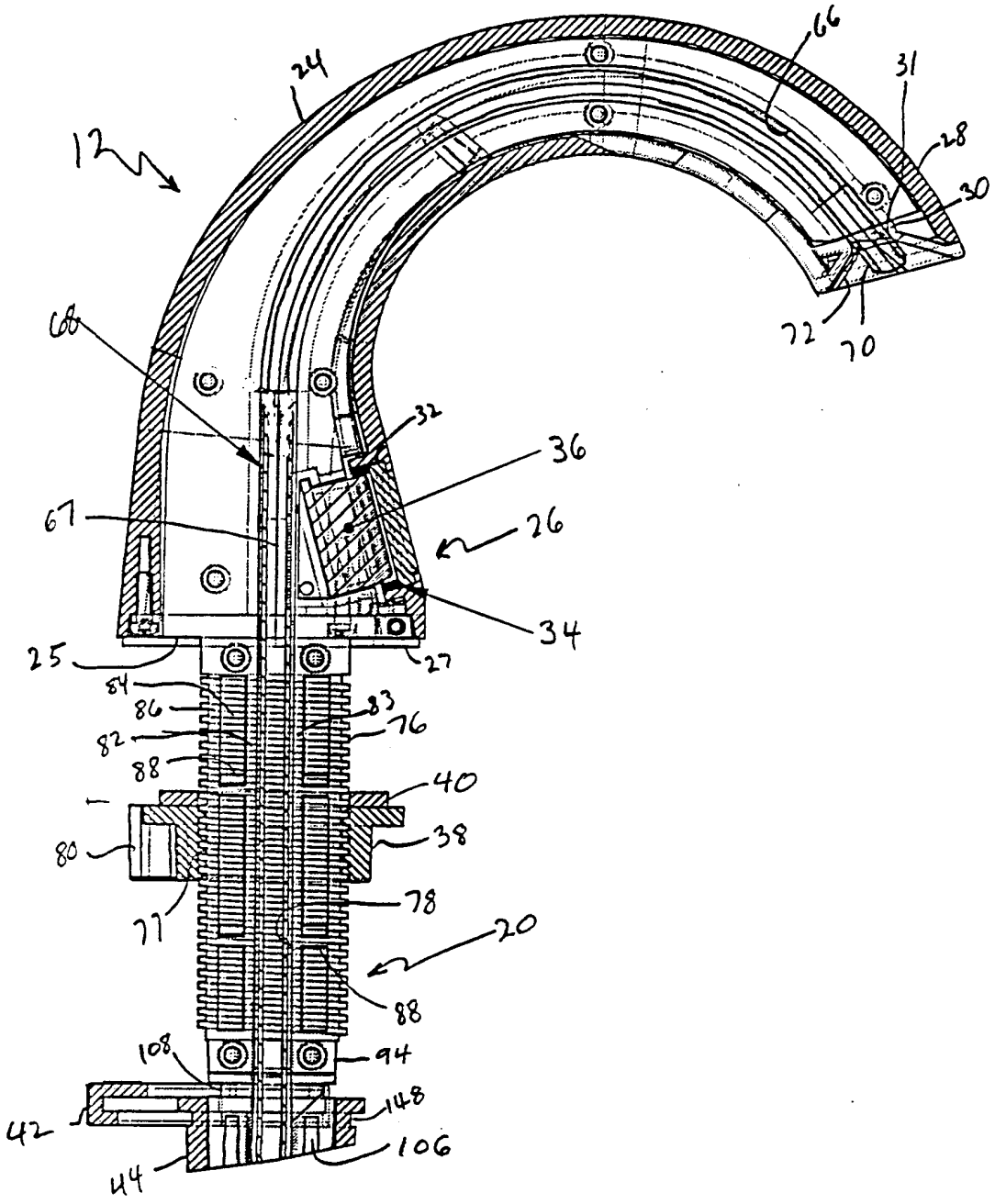
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FIG. 3

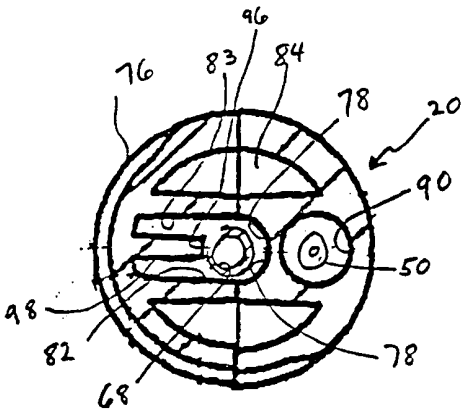


FIG. 4

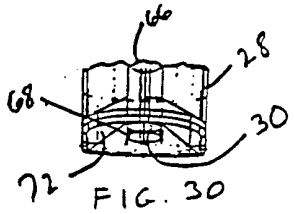


FIG. 30

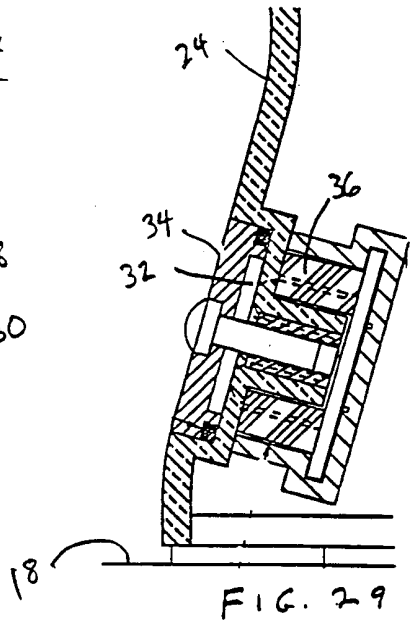


FIG. 29

FIG. 5

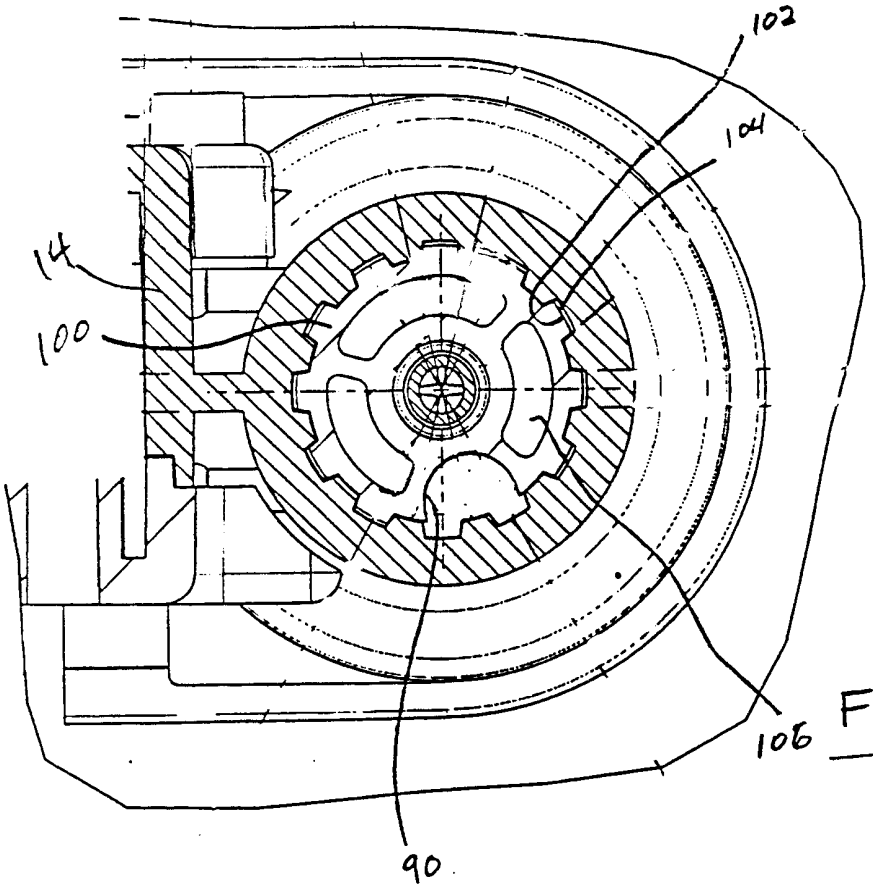
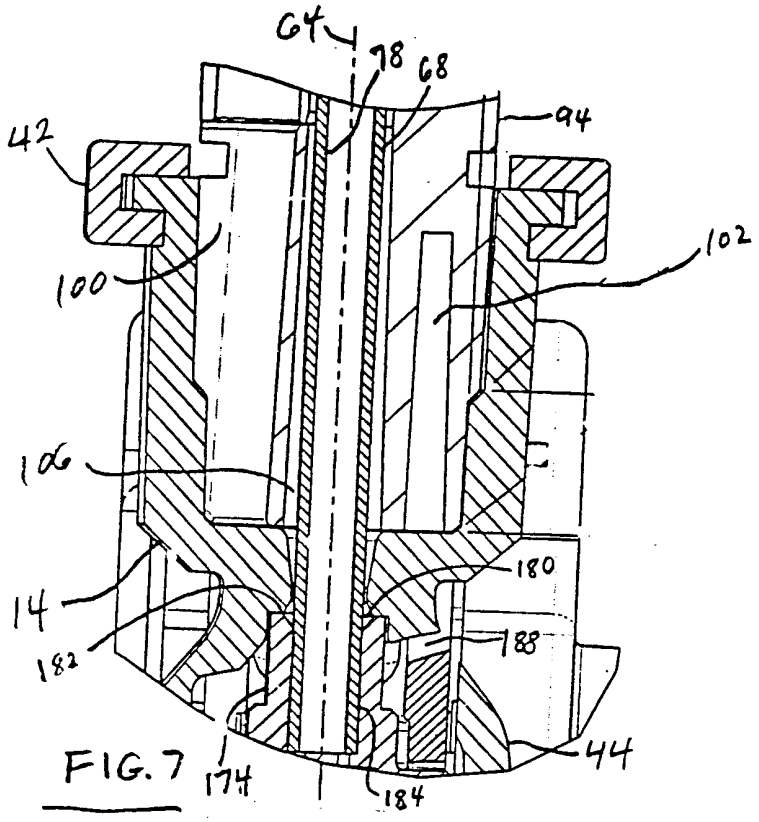


FIG. 6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78
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42
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106
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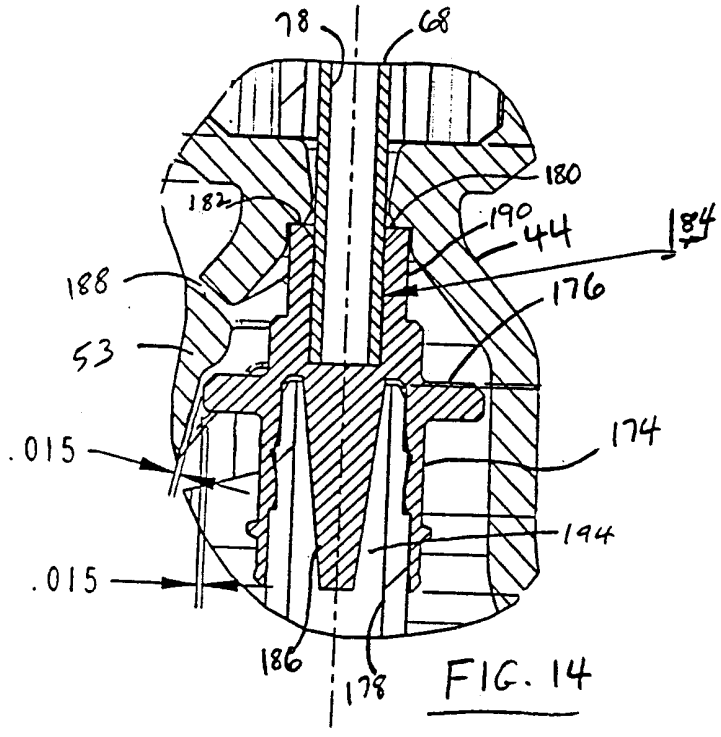
174
184

FIG. 7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.015
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194
.015
186
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FIG. 14

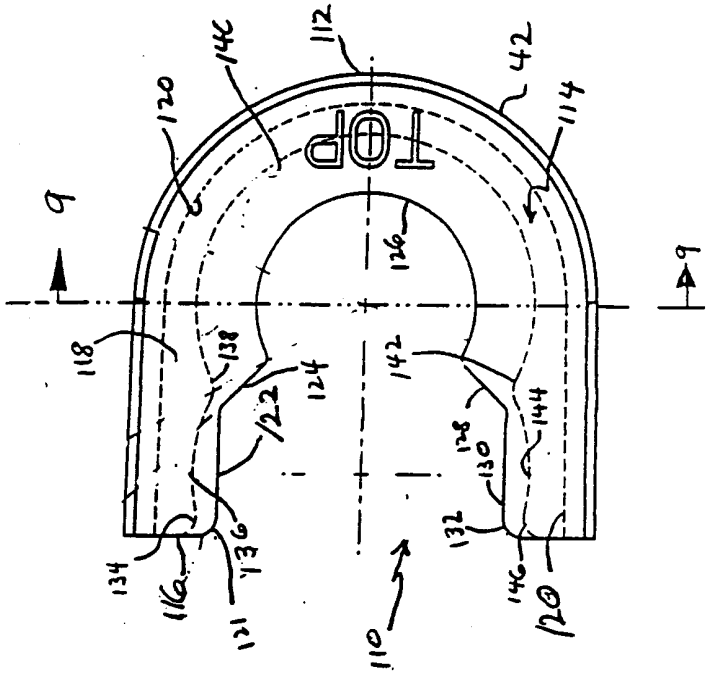

FIG. 8

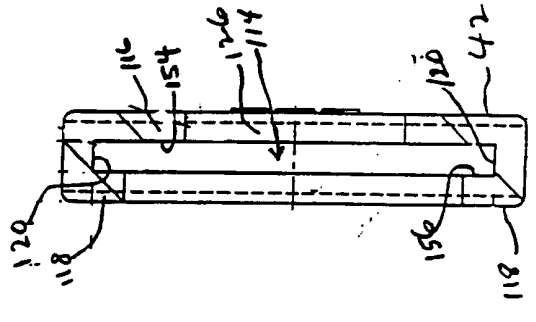

FIG. 9

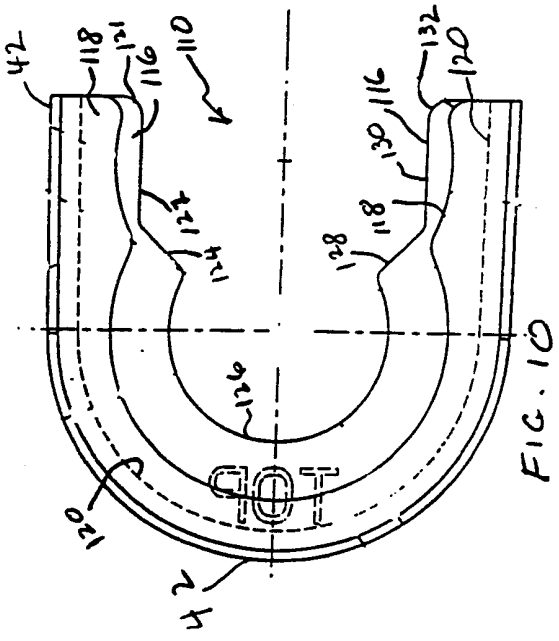

FIG. 10

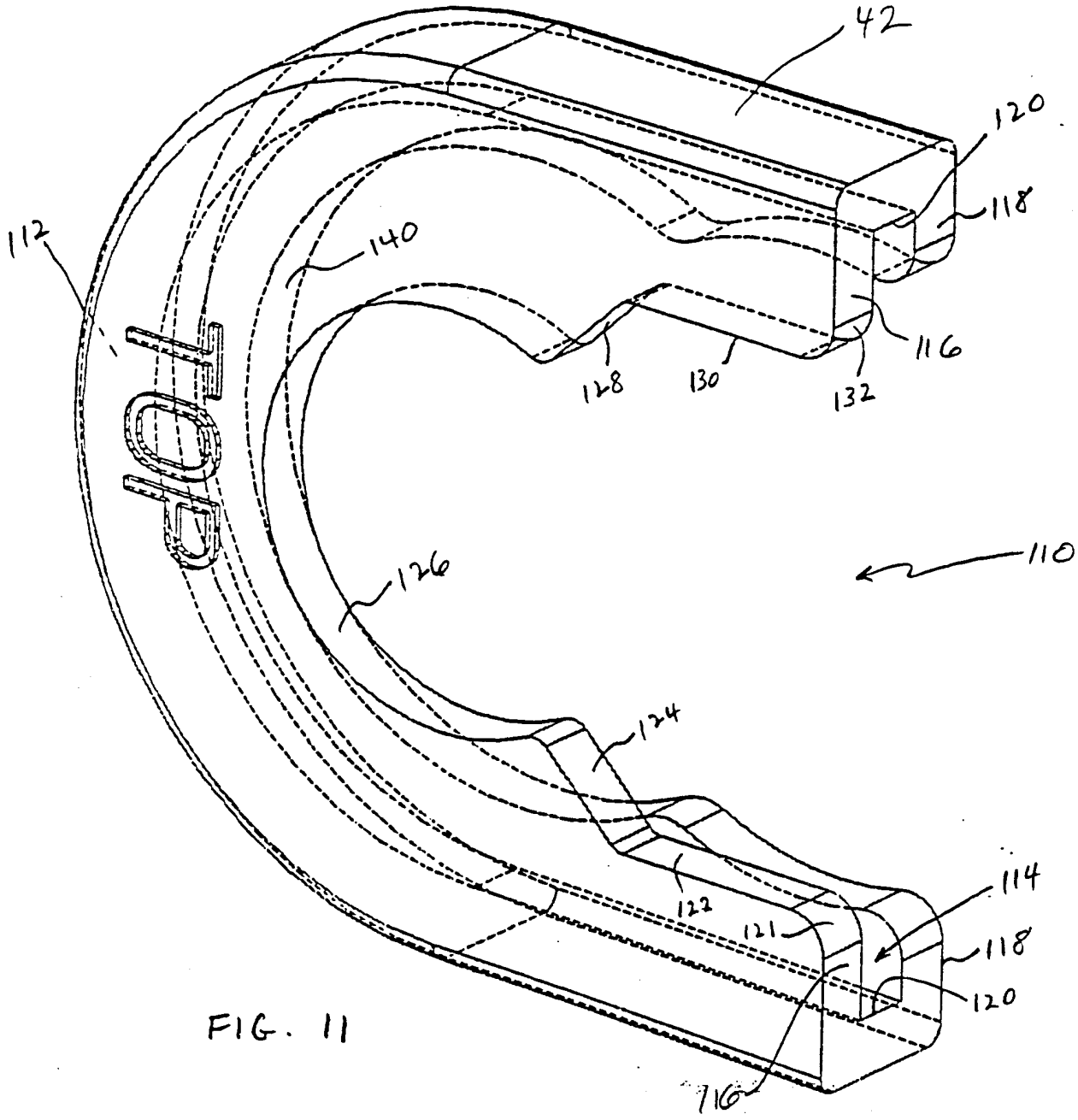
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FIG. 11

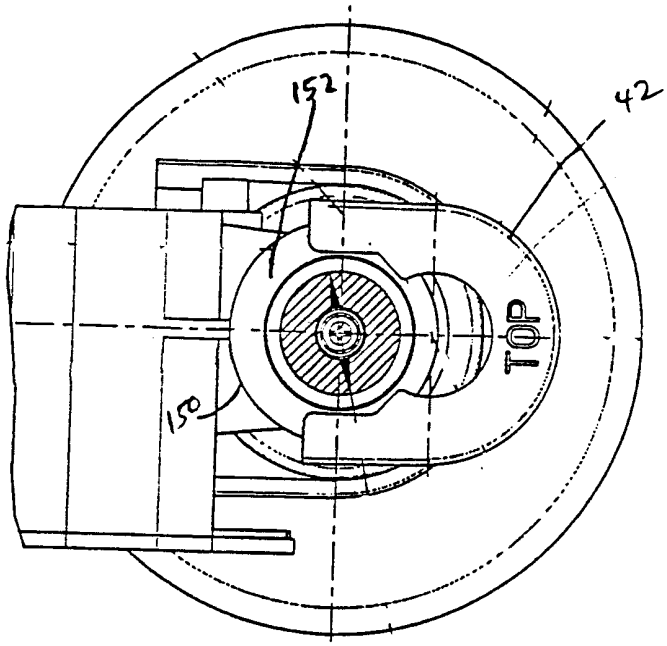

FIG. 12A

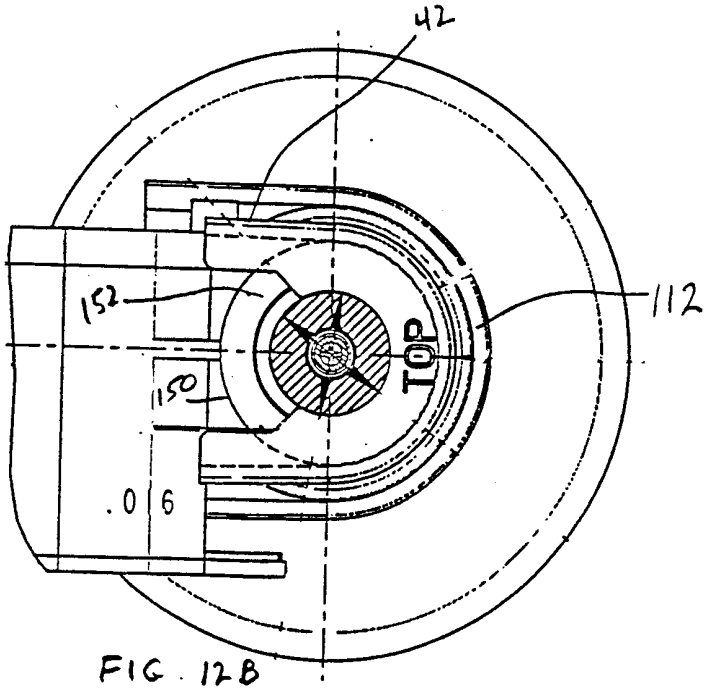

FIG. 12B

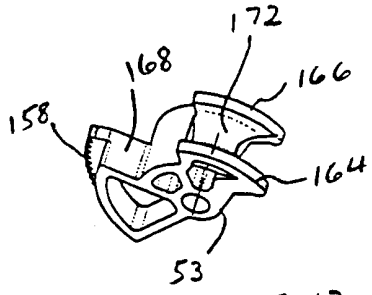

FIG. 13

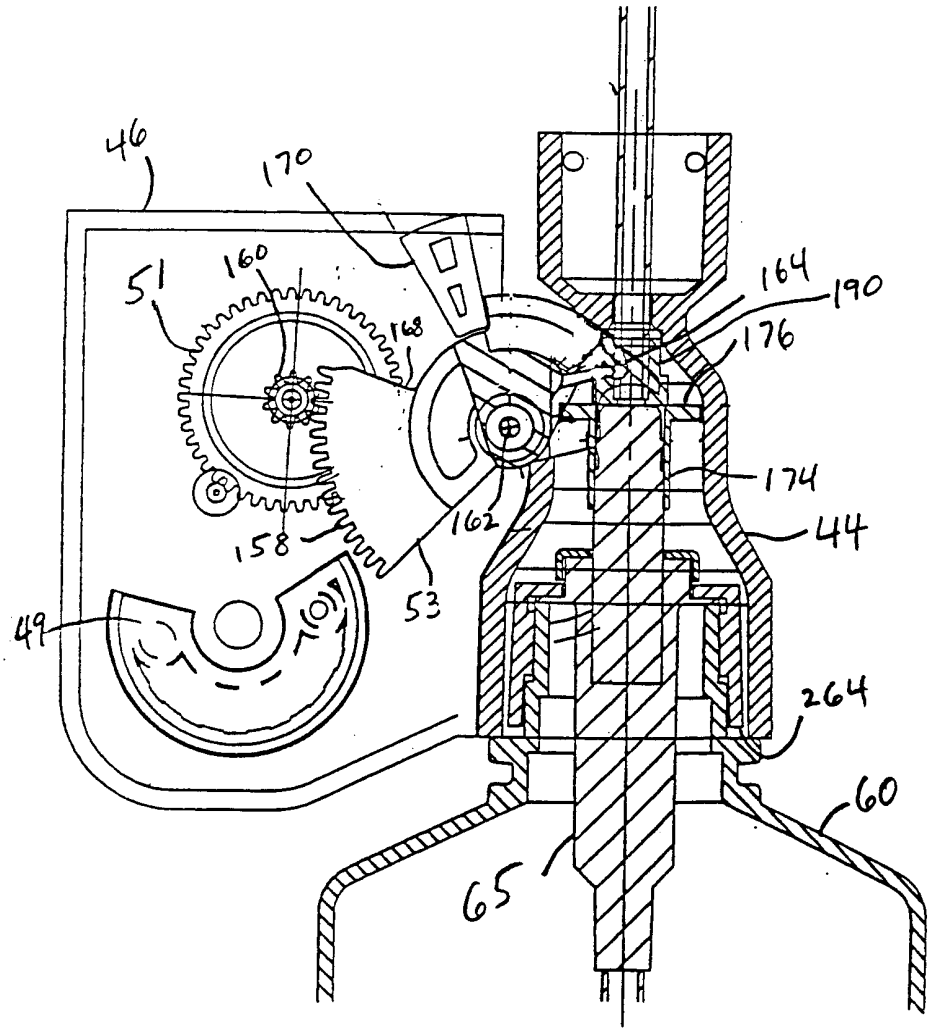

FIG. 15A

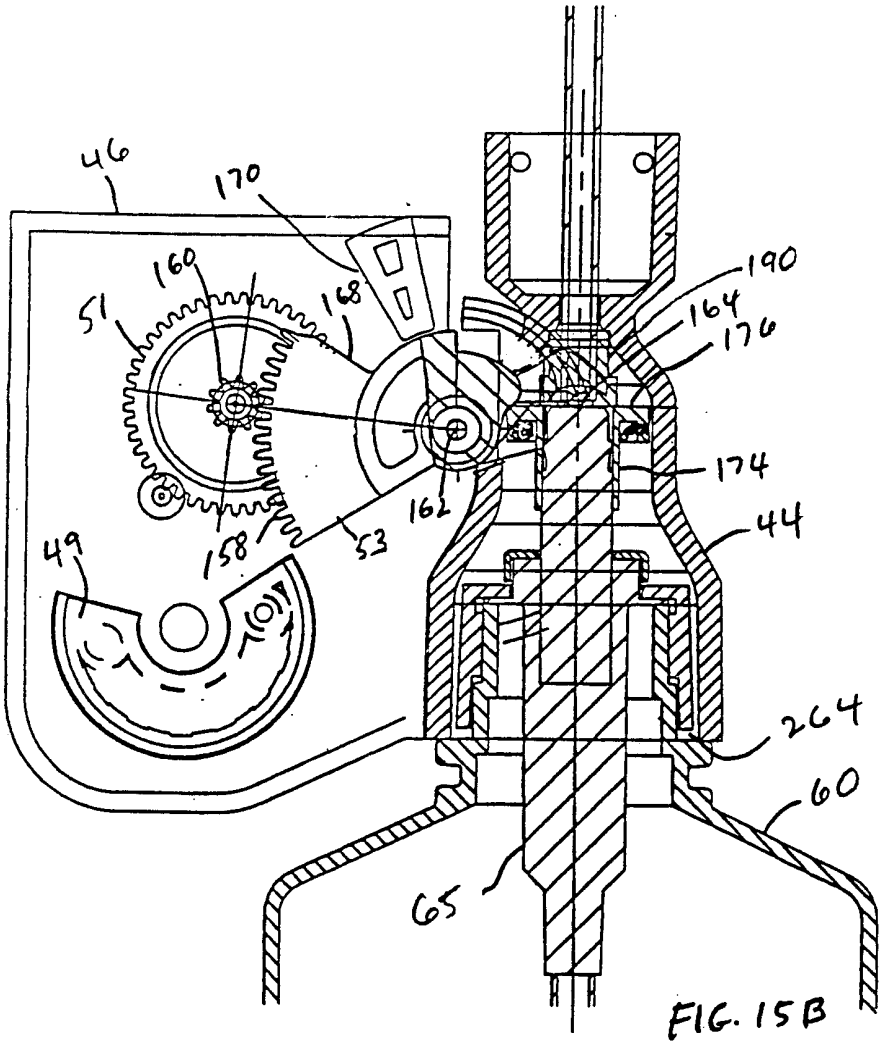

FIG. 15B

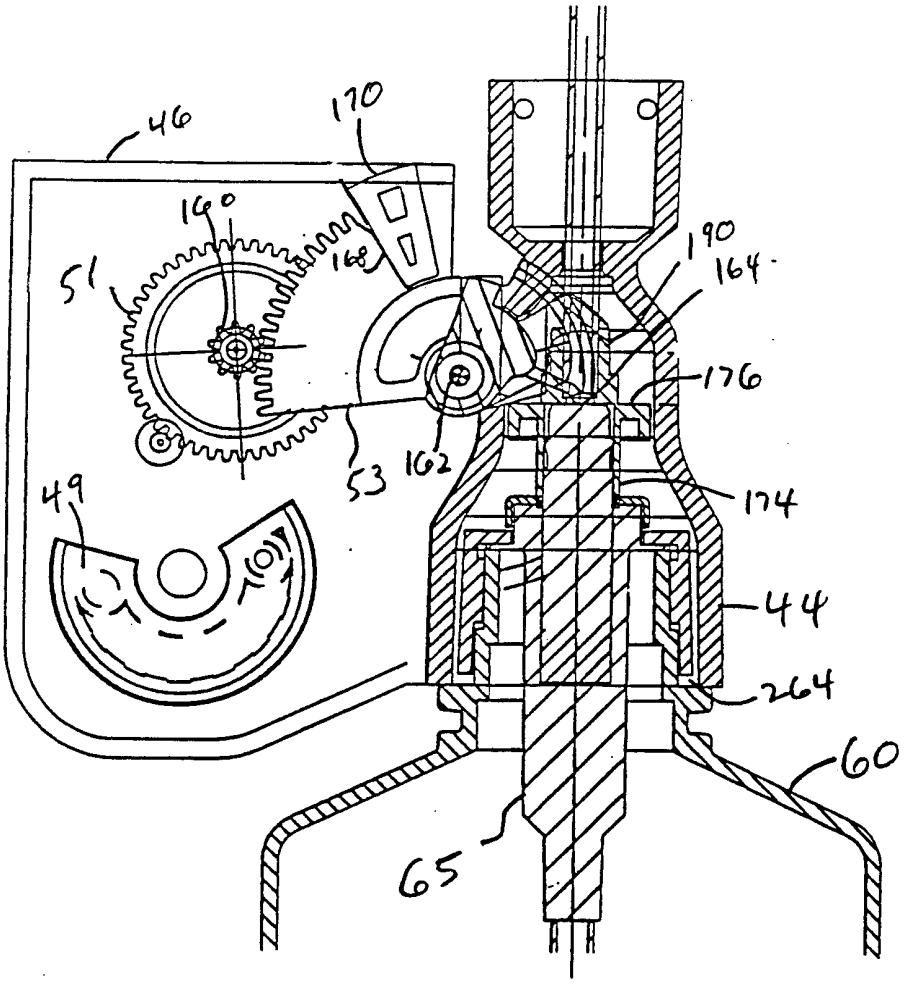

FIG 15C

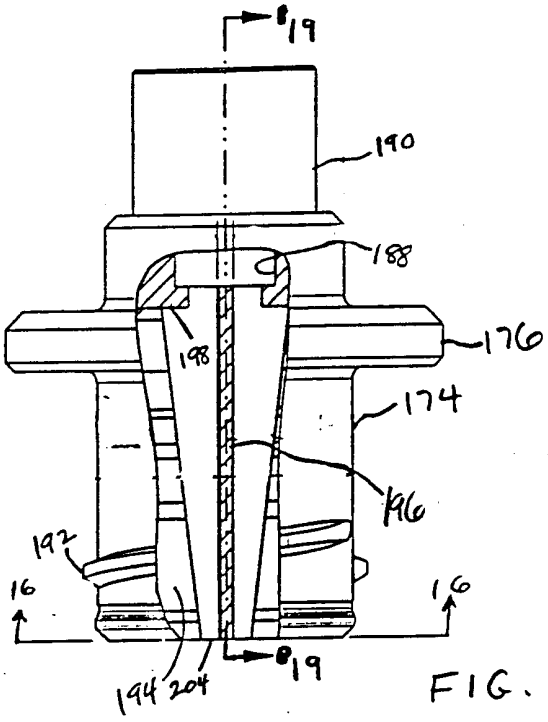
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FIG. 17

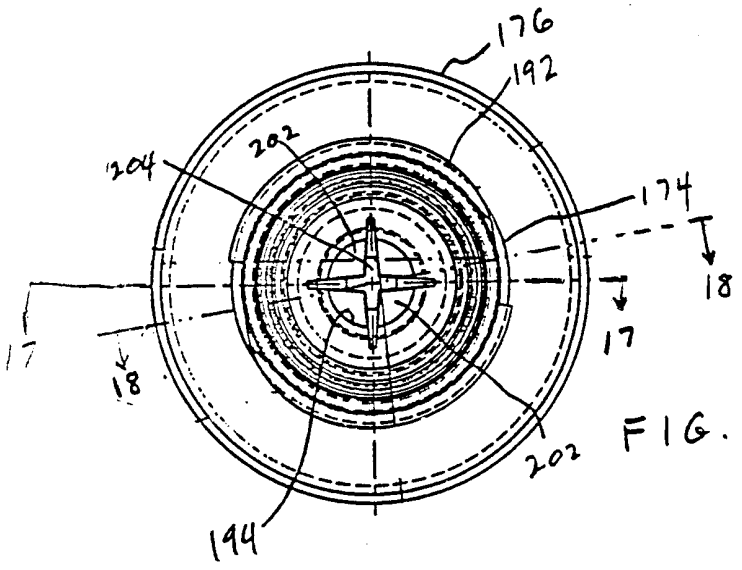
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FIG. 16

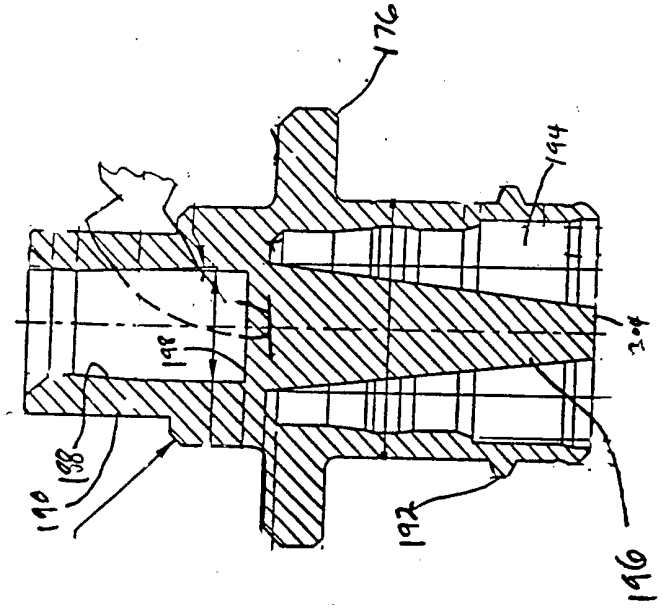
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FIG. 19

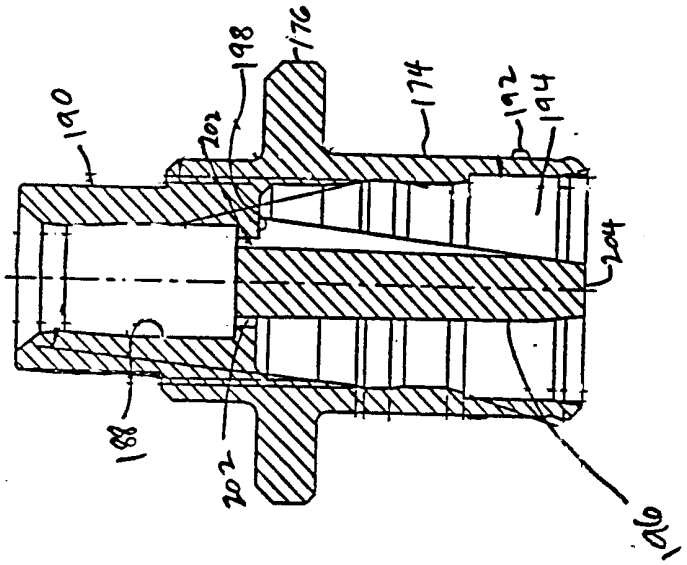
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FIG. 18

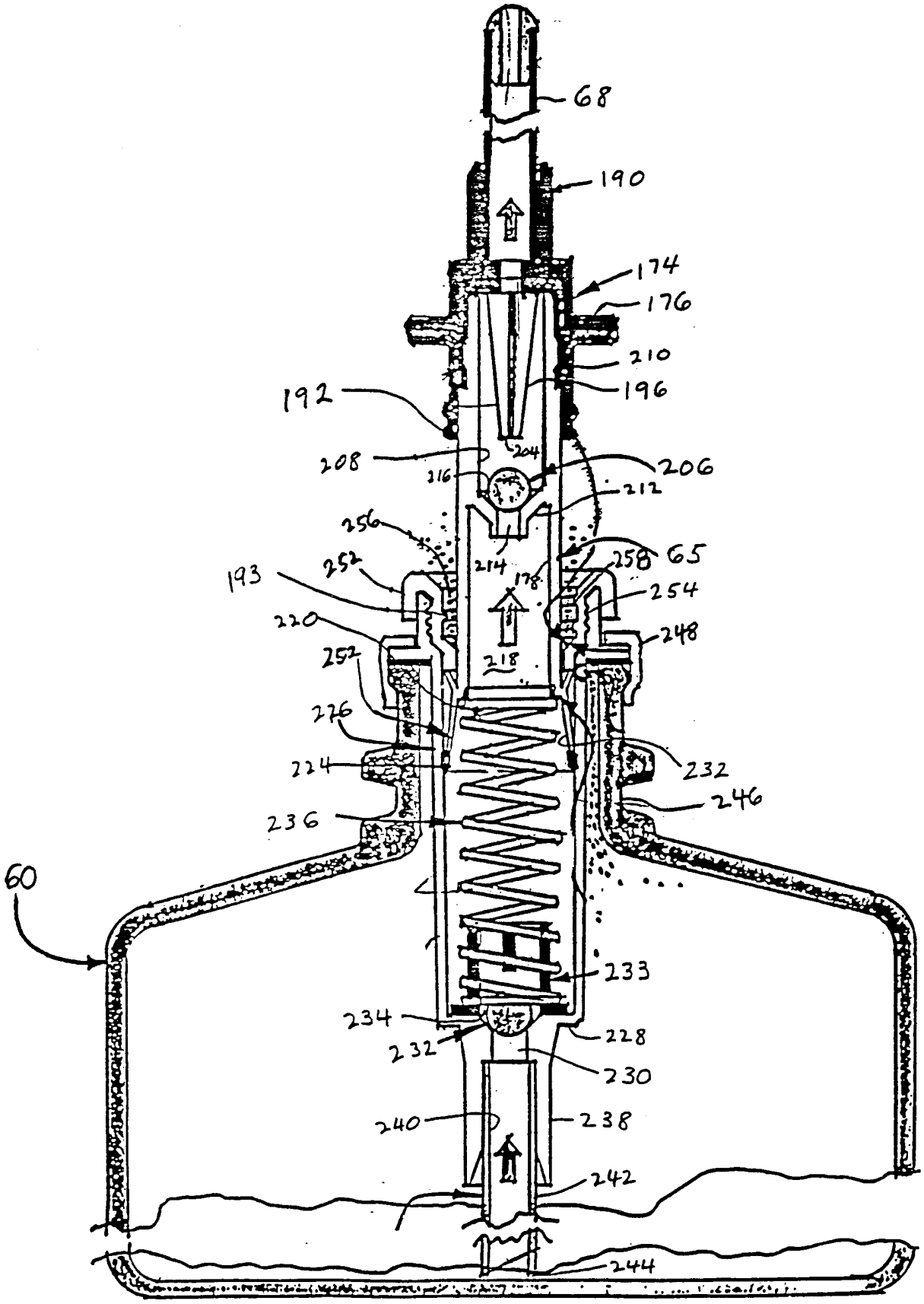
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FIG. 20

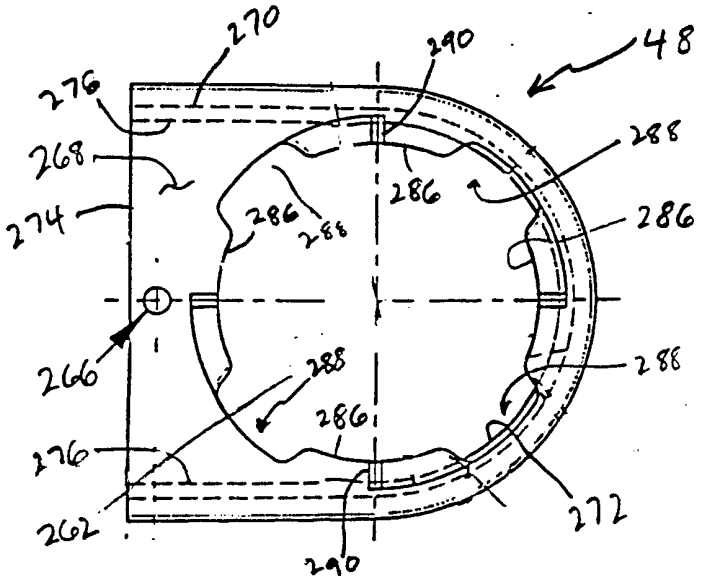
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FIG. 21

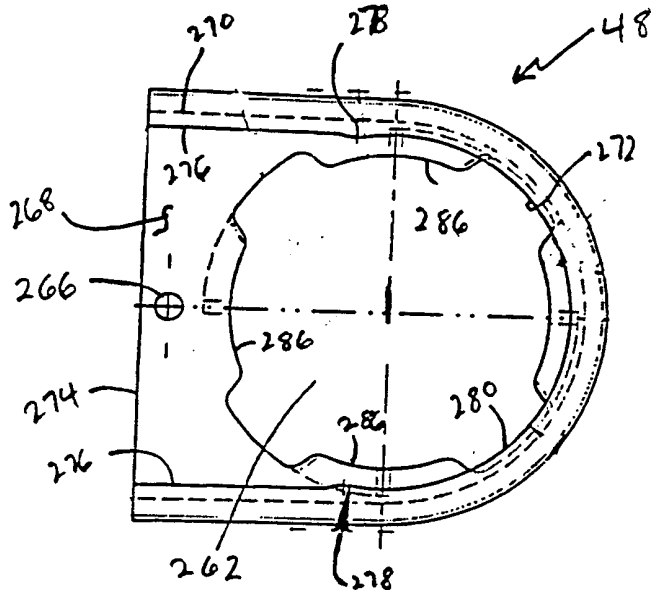
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FIG. 22

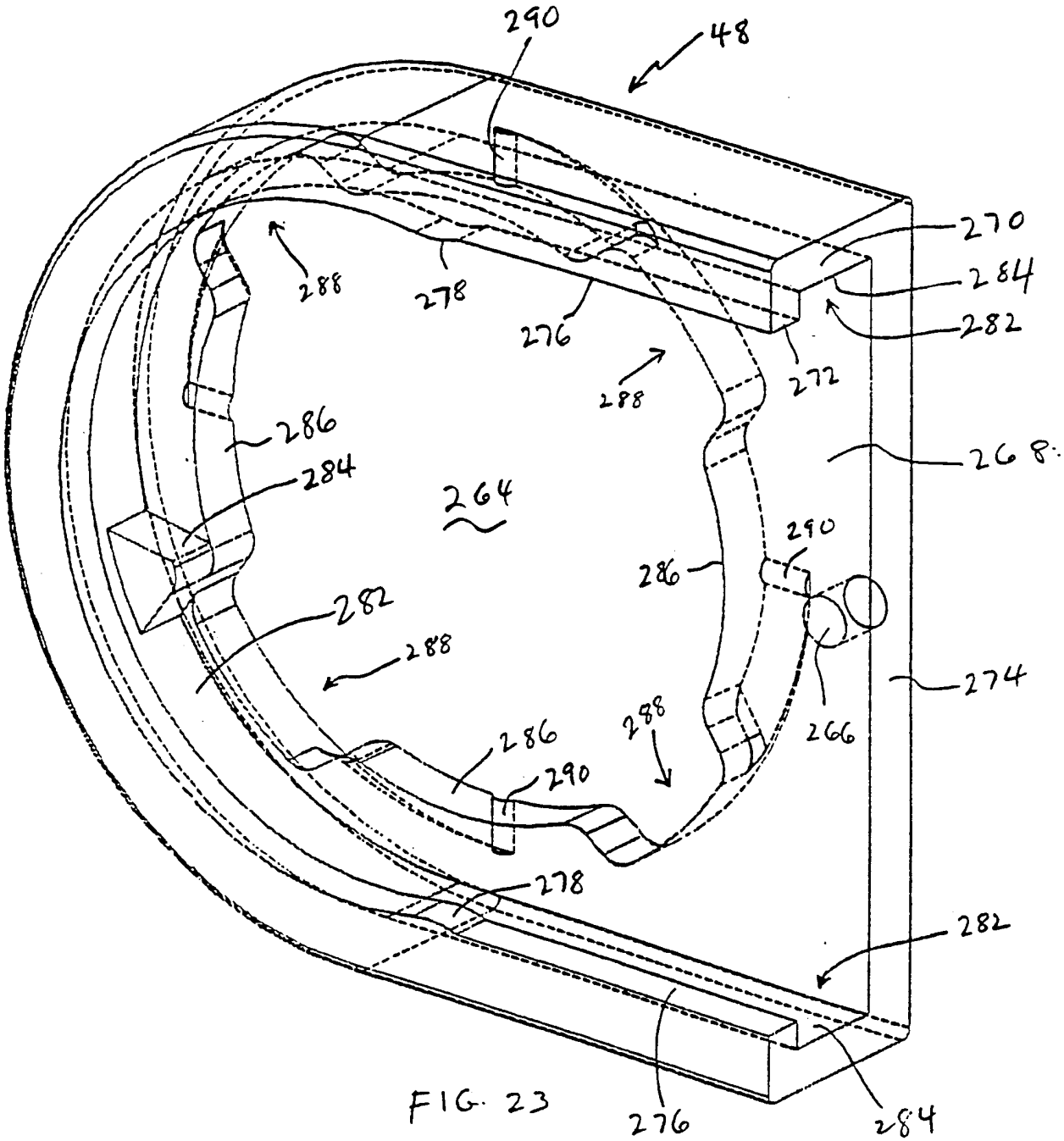
290
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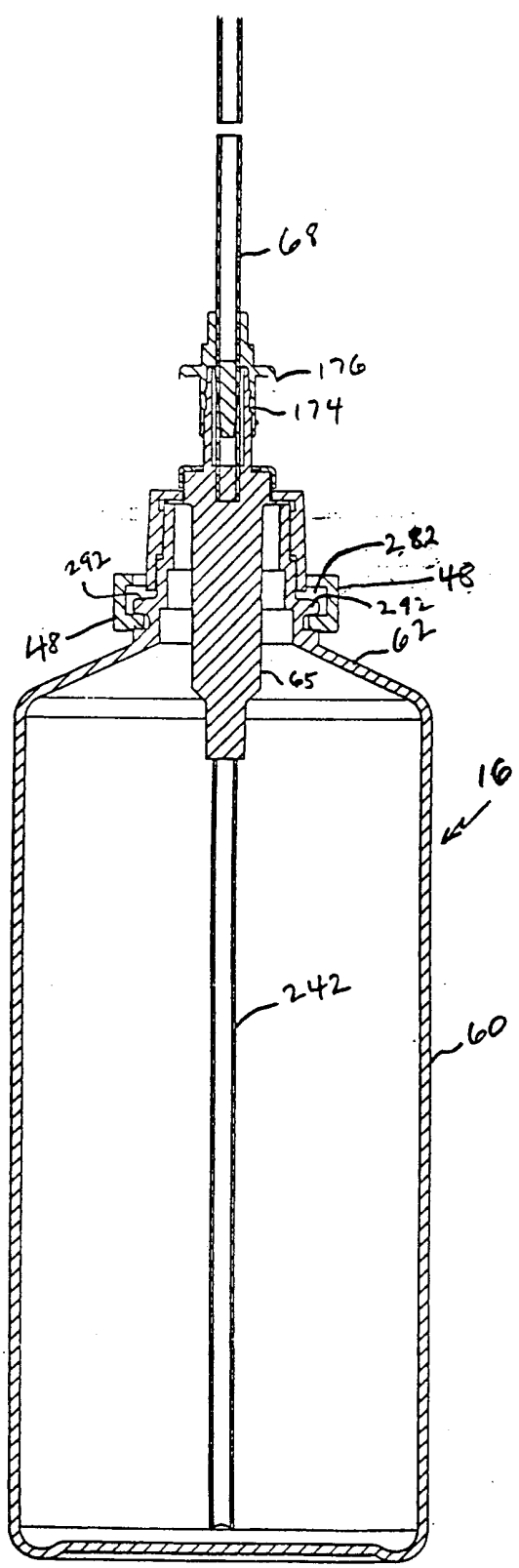
FIG. 23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174
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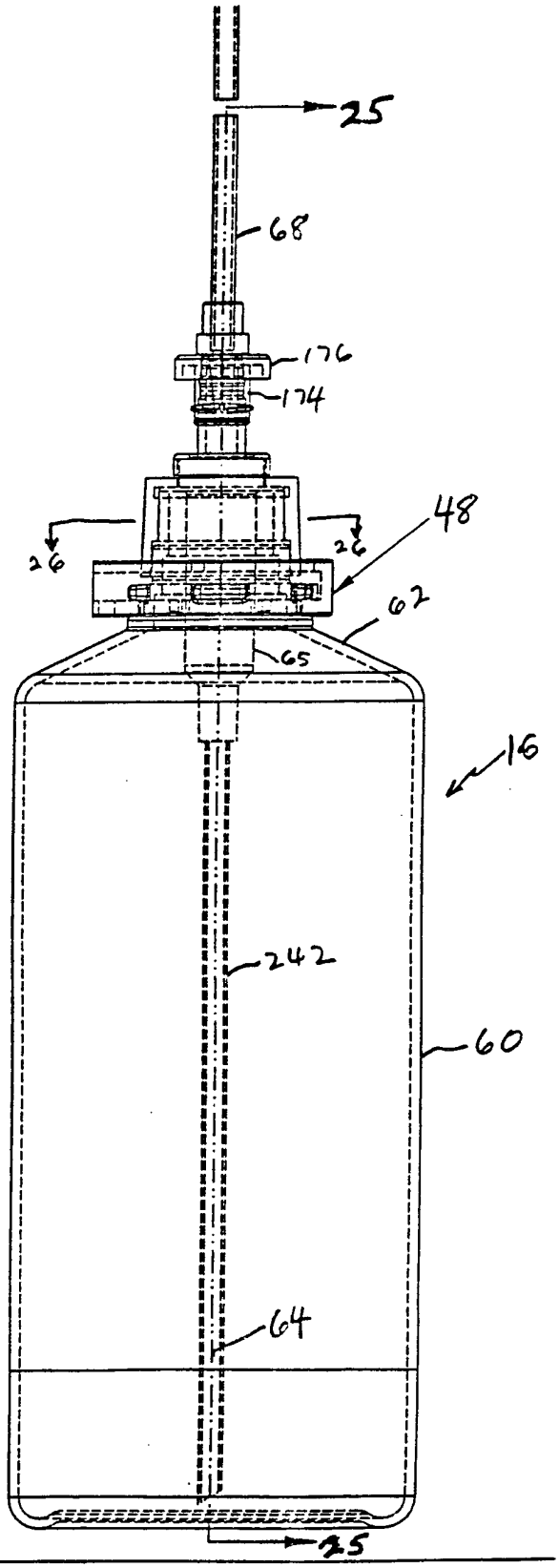
FIG. 25


25
68
176
174
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62
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242
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64
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FIG. 24

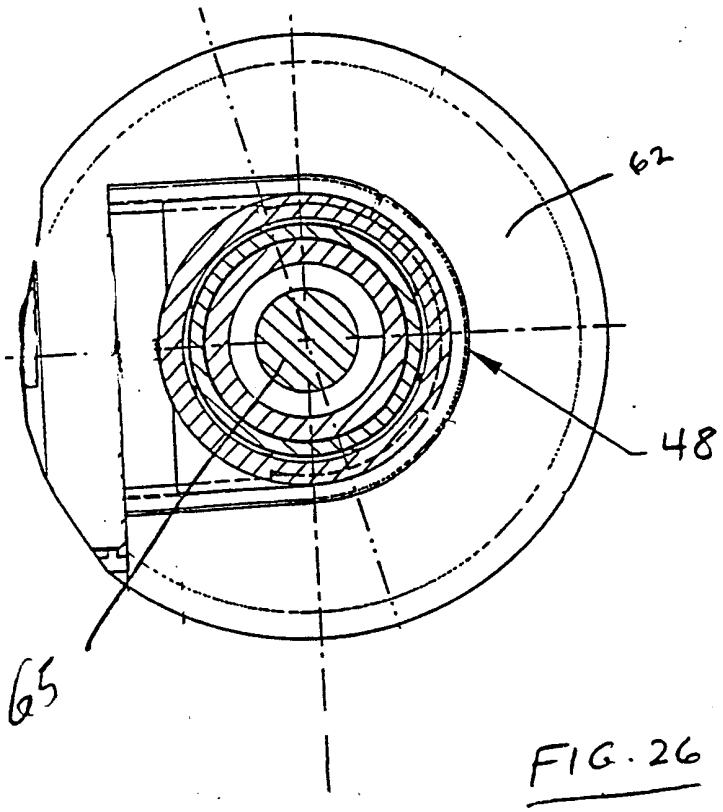

FIG. 26

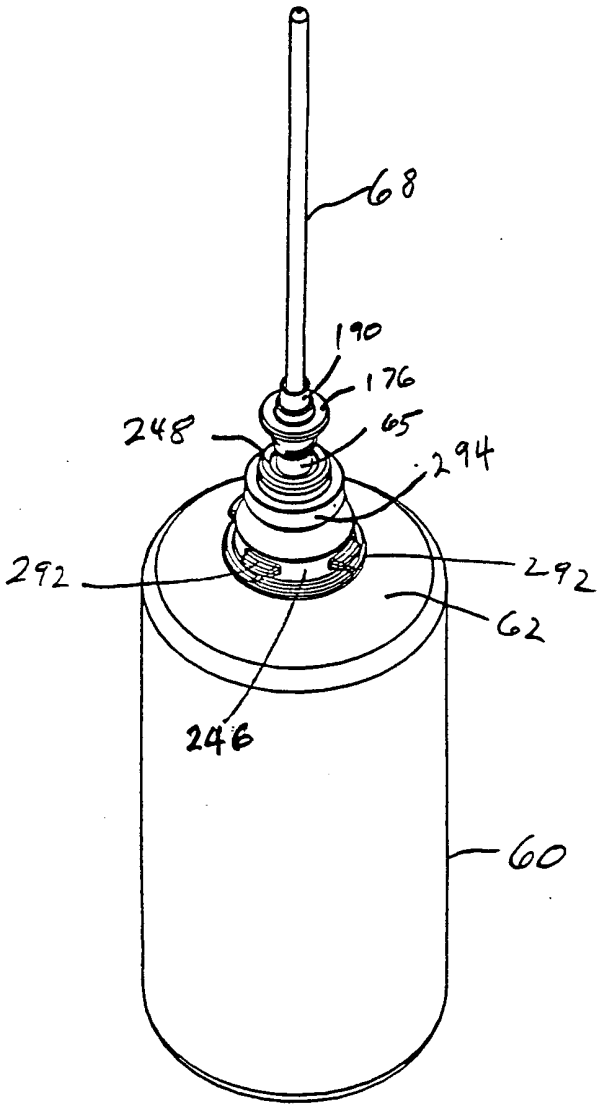

FIG. 27

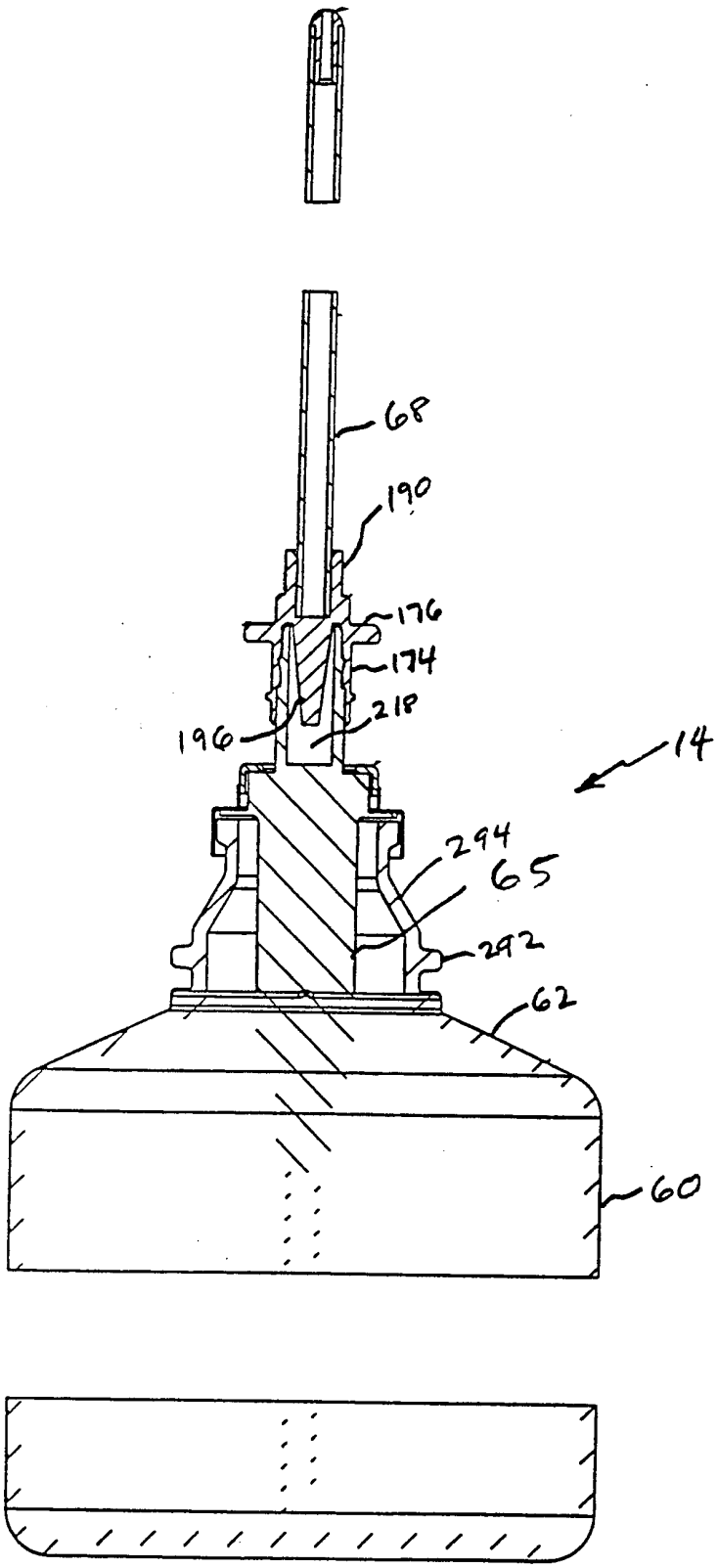

FIG. 28

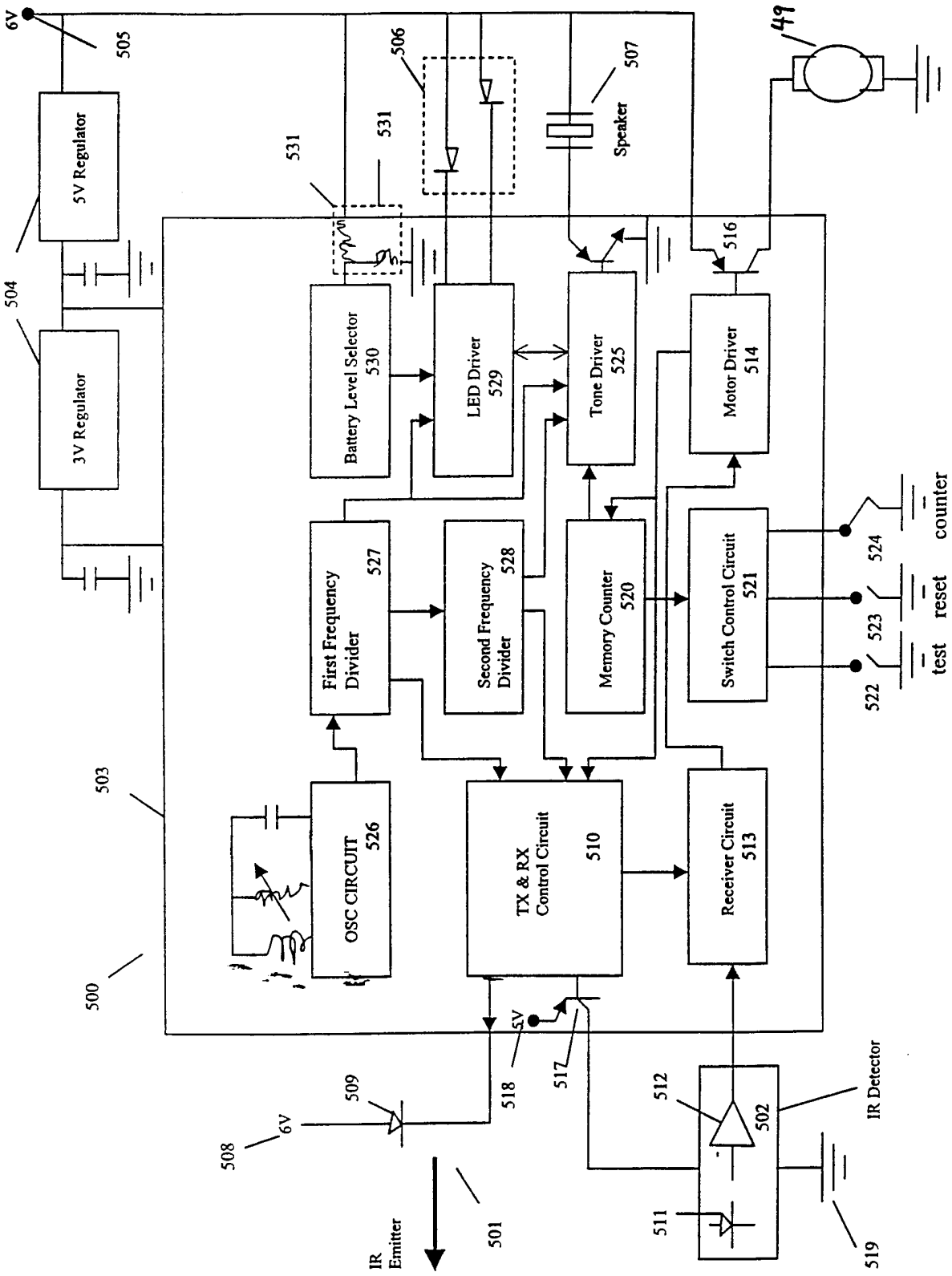
6V
505
5V Regulator
504
3V Regulator
506
531
531
Speaker
507
49
516
Battery Level Selector 530
LED Driver 529
Tone Driver 525
Motor Driver 514
First Frequency Divider 527
Second Frequency Divider 528
Memory Counter 520
Switch Control Circuit 521
524
523
522
test
reset
counter
503
OSC CIRCUIT 526
TX & RX Control Circuit 510
Receiver Circuit 513
500
5V
518
517
512
502
IR Detector
509
6V
508
IR Emitter
501
511
519

FIG. 31

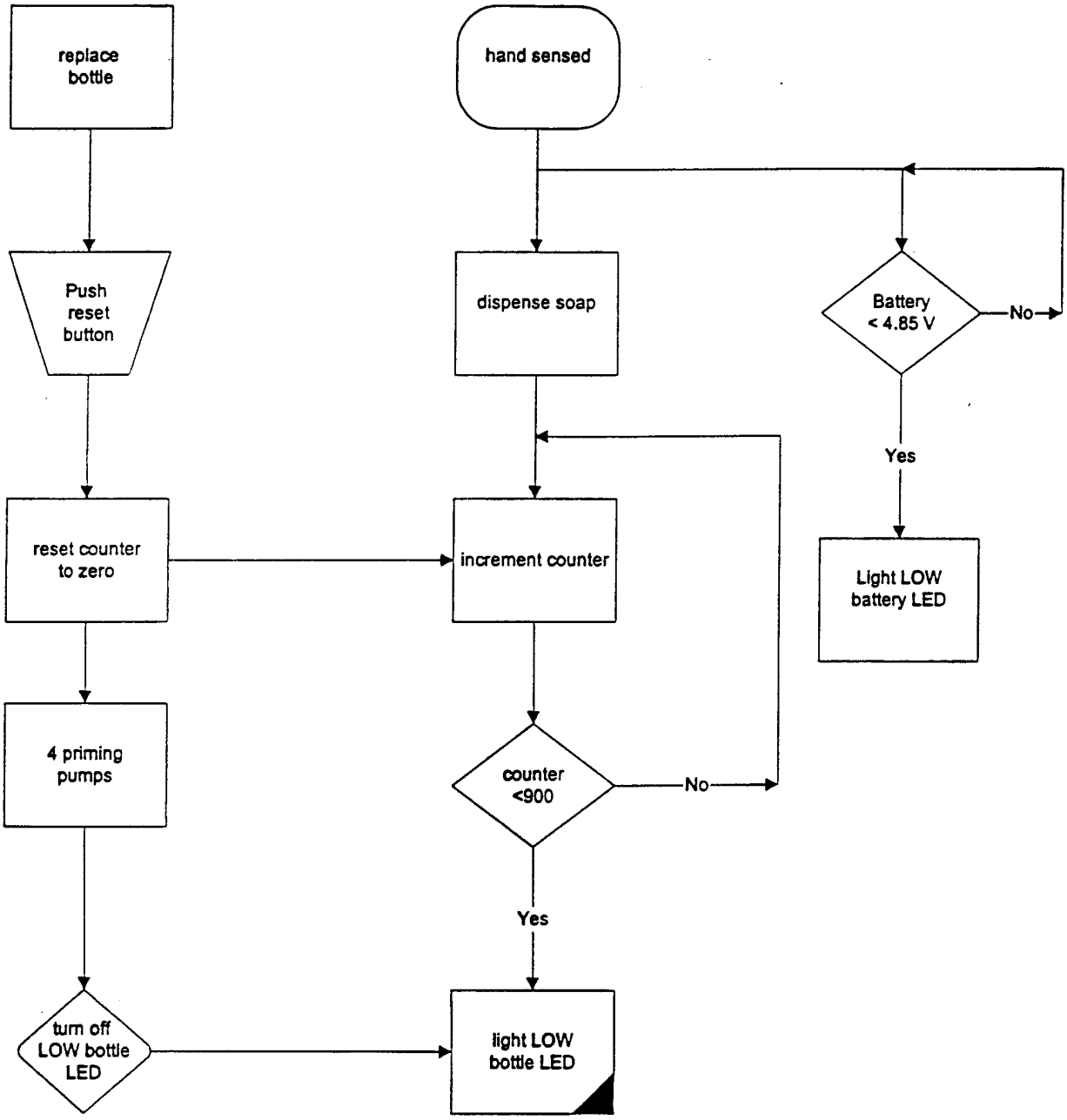
replace bottle
Push reset button
reset counter to zero
4 priming pumps
turn off LOW bottle LED
hand sensed
dispense soap
increment counter
counter <900
No
Yes
light LOW bottle LED
Battery < 4.85 V
No
Yes
Light LOW battery LED

FIG. 32

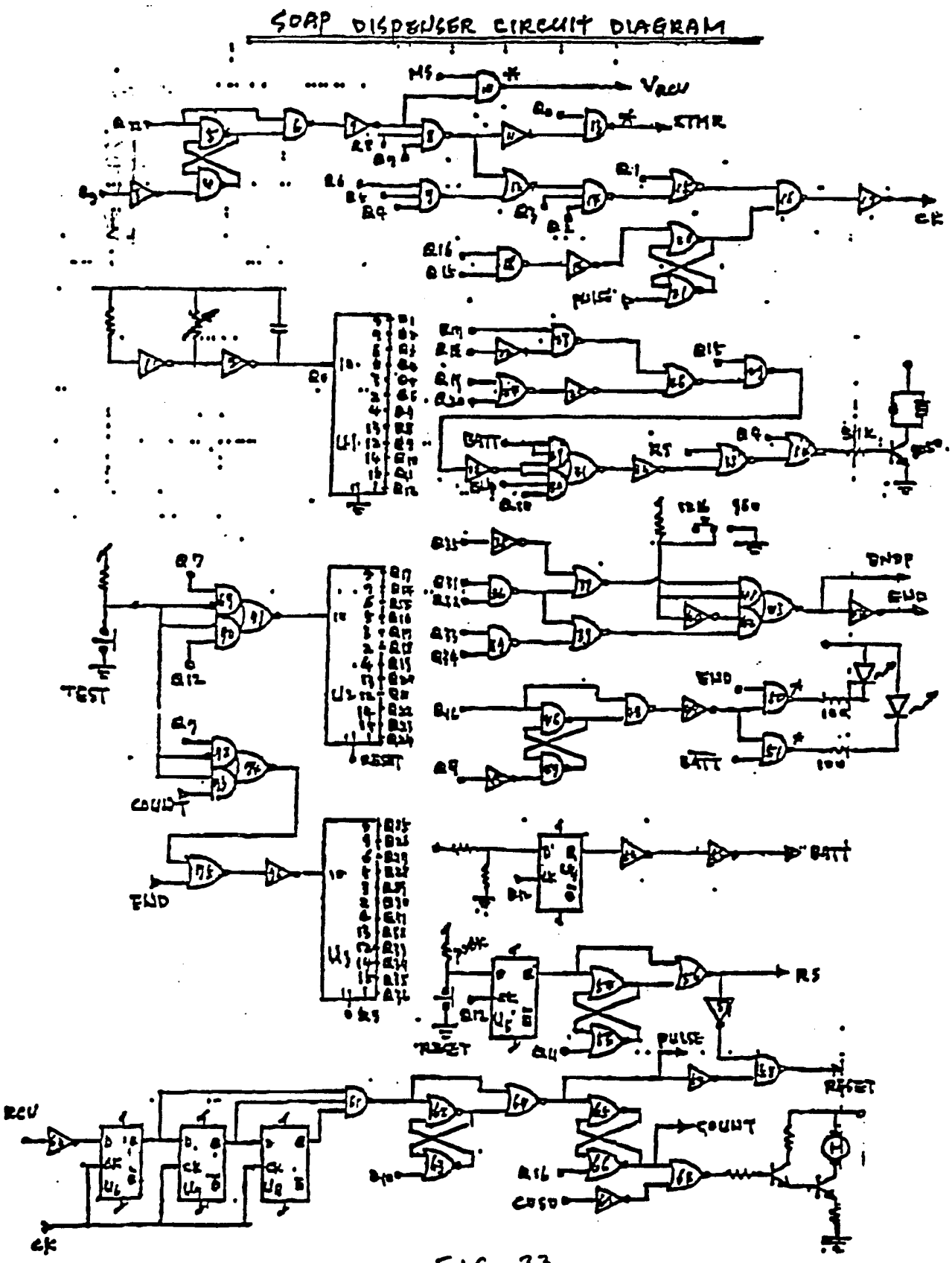
SOAP DISPENSER CIRCUIT DIAGRAM
VRCV
ETHR
CK
PULSE
BATT
RST
TEST
COUNT
END
RESET
RCV
CK
COUNT
RESET
PULSE

FIG. 33

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/41032

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G01F 11/00
US CL :222/1, 63, 333

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 222/1, 52, 63, 333

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,938,384 A (PILOLLA et al.) 03 July 1990, see entire document.	1-15
A	US 5,632,414 A (MERRIWEATHER, Jr.) 27 May 1997, see entire document.	1-15
A	U.S 5,226,566 A (BRANDENBURG) 13 July 1993, see entire document.	1-15
A	U.S 5,476,197 (LAWRENCE et al) 19 December 1995, see entire document.	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 10 JANUARY 2001	Date of mailing of the international search report 30 JAN 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer KEVIN P. SHAVER Telephone No. (703)305-6385

Form PCT/ISA/210 (second sheet) (July 1998)★