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(54) **MULTI-CAVITY WASHING APPARATUS.**

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Description

This invention relates to washing of small cavities, for example, arrays of wells in a microtitration plate. In diagnostic and epidemiological investigations it is a common practice to test a number of biochemical reactions collectively in the wells of a microtitration plate. At various stages in such tests it is necessary to wash out the wells. For example in enzyme immunoassay (EIA) it is necessary to wash out each well between each step to remove unabsorbed or unreacted substances.

Manually operated single row washers are currently available which wash the wells of microtitration plates one row at a time as part of the EIA technique. The wash process is a careful rinsing of each individual well of the microplate by evacuating the fluid in the well, refilling it with a controlled volume of rinse fluid, allowing a soak period, washing the well again and repeating this process three or more times. On each occasion that the well is refilled the remaining unbound contents are diluted by approximately 100 : 1, thus for a three wash cycle the unbound contents are diluted by 10^6 : 1. It is important that the wash is carefully controlled so that none of the attached components are stripped from the well. Also it is preferable that there should be no overflowing leading to cross-contaminating overflow between wells.

An example of a manually operated single row washer is the Titertek Handiwash manufactured by Flow Laboratories Limited. Another example of a manually operated single-row washer, and a procedure for its use, is disclosed in European Patent Specification EP 00 80 134-A1 ; in this disclosure, the suction pipes extend a few millimetres longer than the corresponding liquid supply pipes, but not sufficiently longer as not to hinder the suction pipes traversing the bottoms of a selected row of wells. An automatically operated single row washer, and its mode of operation, is disclosed in EP 01 23 786-A1.

One problem that arises with the know well washing apparatus is that unevacuated fluid tends to congregate in the bottom corners of the wells.

According to the present invention there is provided microtitration plate washing apparatus comprising washing liquid supply nozzles (48) and suction nozzles (50), the nozzles (48, 50) being mounted on a vertically moveable head (46) in a row of pairs of nozzles, the row having the pairs of nozzles spaced at the spacing of the wells in a row of wells in a microtitration plate (14) to be washed by the apparatus, each pair of nozzles comprising one supply nozzle (48) and one suction nozzle (50) mounted sufficiently close together that both nozzles in the pair can be simultaneously placed into a single well in the microtitration plate (14) upon lowering of the head (46) by a head-moving mechanism (57-64) within the apparatus, wherein the supply nozzles (48) are con-

nected to a source of wash fluid (80) through a supply control valve (84) and the suction nozzles (50) are connected to a vacuum source through a suction control valve (78), characterised in that the apparatus further comprises a horizontally movable microtitration plate support (16), support moving means (36, 28) for horizontally moving the plate support (16) under the control of a microprocessor to bring a selected row of wells beneath the nozzles (48, 50) and for selectively moving the plate support (16) when the head (46) is lowered to cause the suction nozzles (50) to traverse the bottoms of the selected row of wells, and in that the supply nozzle (48) of each pair of nozzles is sufficiently shorter than the suction nozzle (50) as not to hinder the suction nozzles (50) traversing the bottoms of the selected row of wells the microprocessor means also being operable to open the supply control valve (84) for a given period of time to fill the wells, dwell for a soak period, and then open the suction control valve (78) on lowering the head (46) at a rate sufficiently low in relation to the rate of suction that fluid in the wells is sucked out of the wells without the suction nozzles (50) being immersed in the fluid in the wells.

A specific embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which :

Figure 1 is a view from above of a titration plate washing apparatus incorporating the present invention ;

Figure 2 is a section on the line II-II of Figure 1 ;

Figure 3 is a view from the underside of the apparatus of Figure 1 with the base cut away ;

Figure 4 is a view of a spiral cam plate ;

Figure 5 is a side elevation along the line V-V of Figure 1 with parts omitted for clarity ;

Figure 6 is a plan view of the apparatus of Figure 1 with the cover removed and some parts omitted for clarity ;

Figure 7 is a schematic diagram of a supply pump ;

Figure 8 to 13 are sectional views of various embodiments of a nozzle feed arrangement ;

Figure 14 is a fragmentary view through the head and well illustrating bi-direction movement of the carriage during evacuation of the well ; and

Figure 15 is a fragmentary view through the head and well illustrating a cycle for washing the wells to the rim.

Referring to the drawings, apparatus for washing microtitration plates comprises a carriage 16 which runs beneath a liquid dispensing head 46. Rinsing fluid supply nozzles 48 and suction nozzles 50 project downwardly from the head 46. Rinsing fluid supply nozzles 48 and suction nozzles 50 project downwardly from the head 46. The nozzles can be lowered into a row of wells in the plate 14 by movement of the head 46 about a pivot 55 (see Fig. 5). The carriage 16

containing the plate 14 is moved under the nozzles to align a row of wells beneath them in order to perform a washing operation. The washing process comprises filling the wells with rinsing fluid from the supply nozzles 48 and evacuating the fluid by means of the suction nozzles 50. The raising and lowering of the dispensing head and the movement of the carriage are effected by stepper motors 36 and 57 controlled by a preprogrammed microprocessor. The microprocessor offers several different washing cycles from which the user can select one suitable for his requirements.

Referring to Figures 1, 2 and 3, a housing 9 consists of a base portion 10 connected with a front wall 5, a rear wall 6, and side walls 7 and 8, thus providing a rigid supporting structure on which the well-washing apparatus is constructed. A cover 11 rests on the front, rear and side walls 5, 6 and 8 and extends across the left hand half of the apparatus as viewed in Fig. 2

A microtitration plate 14, shown cut away for the sake of clarity, is held in position on a carriage 16. The microtitration plate 14 for use with this apparatus is the common 8 × 12 rows type of clear transparent moulded plastics material. Usually each well is formed with a flat bottom such that the extent of a reaction in a well can be measured optically according to the amount of light passed by the reacted substance in each well.

The carriage 16 is rectangular with a raised lip 15 around its edge to locate the plate and an upper surface 17 which is shaped as a shallow funnel sloping down towards a central drain hole 13 to collect spillage from the plate. The carriage 16 travels from front to back on a linear track to one side of the housing. The track comprises a rail 18 and a groove 19 fixed on the housing. The rail, which is mounted on the cover 11 adjacent the side wall 7 of the housing, comprises a rod 18 which supports the underside of the carriage 16 along one side (see Fig. 2). The opposite side of the carriage 16 is secured to an upper portion 25 of a carriage arm 24. The upper portion 25 of the arm is enlarged and engages the groove 19 in the cover to support the carriage on the right hand side and guide the carriage for linear movement along the track. A spring 27 mounted on the arm 24 bears against the underside of the cover 11 to hold the carriage 16 on the cover and maintain the enlarged portion 25 of the arm in the groove 19. Between the groove 19 and the rail 18 the cover 11 is shaped as a shallow funnel to form a drip tray 26 which extends for the length of travel of the carriage 16. The tray 26 collects fluids spilt from the carriage and funnels them into a central drain hole 20 which is connected via a pump (not shown) to a suitable reservoir. A gauze filter 21 is located within the drain hole 20.

The carriage 16 is moved along its linear track by the stepper motor 36 via a lead screw mechanism 28.

The narrower lower portion of the carriage arm 24 extends downwardly from its enlarged upper portion 25 through a slot 29 in the cover 11 alongside the drip tray 26 and is secured to a lead screw sleeve 23 of the lead screw mechanism 28. A lead screw 30 is rotatably mounted at one of its ends in a ball race bearing 32 mounted on the rear wall 6 of the housing 9 and is attached at its other end to the shaft of the stepper motor 36 mounted adjacent the front wall 5 of the housing 9. The lead screw sleeve 23 engages the lead screw thread by means of a pair of spaced threaded plastics bushes 38 secured to the inside of the sleeve 23 to provide smoother running characteristics than would a metal equivalent. To maintain a clean thread on the lead screw 30 it is enclosed within a first bellows-like gaiter 40 attached to the sleeve 23 at one end and to the bearing 32 at the other end, and a second bellows-like gaiter 44 attached to the sleeve 23 at one end and to a sleeve 35 on the stepper motor 36 at the other end. As the sleeve 23 is caused to travel along the lead screw 30 due to rotation of the stepper motor shaft each gaiter 40, 44 will extend or retract in order to accommodate the changing position of the sleeve 23.

The carriage 16 can be moved by the stepper motor 36 from a "home position" at the front of the cover 11 to a rear operating position beneath a dispensing head 46. The rinsing fluid supply nozzles 48 and suction nozzles 50 project downwardly from the dispensing head in pairs. The supply nozzles 48 are sufficiently shorter than the suction nozzles 50 as not to hinder the suction nozzles traversing the bottoms of the wells of the plate 14 (see below). The spacing of the pairs of nozzles corresponds to the spacing of the wells in a row in the microtitration plate 14. In this embodiment the dispensing head 46 and carriage 16 are constructed so as to be used on the standard microtitration plate mentioned previously with an array of 8 × 12 rows. Thus twelve pairs of washing liquid supply and suction nozzles 48, 50 are provided. Clearly more or fewer nozzle pairs could be mounted in a row. The dispensing head is interchangeable and can be swapped for a head having, say, eight pairs of nozzles. It is also possible to have more than one row of nozzle pairs in order to increase the speed of the washing process.

Each suction nozzle 50 projects vertically downwardly from the dispensing when the dispensing head 46 is in an evacuating position and is of sufficient length to enable it to draw fluid from the bottom of a well in the microtitration plate 14. Each supply nozzle 48 is mounted at a slight angle to and is terminated short of its corresponding suction nozzle 50. The supply nozzles 48 may be mounted at an angle to the suction nozzles 50 so as to allow the washing liquid to set up a swirling motion as it enters the well from the nozzle 48 to enhance its cleaning action. Figures 8 to 11 illustrate two forms of supply nozzle 48 which may

be used in the dispensing head 46, with the dispensing head lowered to a filling position with respect to the well to be washed. Alternatively, the supply nozzle 48 could be arranged as shown in Figures 12 and 13 in which the supply and suction nozzles lie parallel to one another.

The dispensing head 46 is detachably connected to an interconnect 52 illustrated in Figure 5, such that suction and supply bores 54, 56 in the dispensing head 46 are communicated through the interconnect with a suction pump (not shown) and a supply pump 80. The suction and supply bores are connected within the head to the suction and supply nozzles 50 and 48 respectively. The cross-section of the supply bore 56, connecting the nozzles 48 with the interconnect 52, is of sufficiently large diameter in relation to the cross-section of the nozzles that there is no significant pressure difference between the fluid at the different nozzles.

The interconnect 52 is pivotably supported on a post 49 secured to the rear wall 6 of the housing 9, by means of a leaf spring 55 and is raised and lowered about that pivot by means of a second stepper motor 57 (see Fig. 5). On a shaft 58 of the second stepper motor 57 is mounted a scroll cam plate 60 shown in Figure 4. In the surface of the plate 60 facing away from the stepper motor 57 is a spiral scroll groove 62 which progresses outwardly from about the centre of the plate 60. Engaged in the groove 62 on the cam plate 60 is a pin 64 which projects from a downstop arm 66 secured to the base of the interconnect 52. By rotating the second stepper motor 57 the fixed pin 64 is moved upwardly or downwardly as the path of the groove 62 moves past it. This causes the down-stop arm 66 to rise and thus tilt the interconnect 52 and dispensing head 46 about the pivotal leaf spring 55. The advantage of the leaf spring 55 is that it does not suffer from backlash when the direction of movement of the head 46 is changed.

In order to maintain the pin 64 bearing against one wall of the groove 62 during travel of the head 46, the interconnect/dispensing head assembly 68 is biased downwardly by means of a spring 70 secured between the interconnect/dispensing head assembly 68 and a bracket 71 fixed to the rear wall 6 of the housing 9. The inner end of the spiral groove 62 in the cam plate 60 is flared in its width such that when a lower face on the downstop arm 66 abuts a stop surface 73 on an adjustable lever 72 as the down stop arm 66 and hence the dispensing head 46 are lowered into the evacuating position, the pin 64 is allowed to disengage from the said wall of the groove 62 against which it bears as a result of gravity and the additional restraining force exerted by the spring 70. The lever 72 is pivoted about a point 76 such that rotating a graduated dial 98 on a threaded shaft 74 mounted in the side wall 7 draws the lever 72 upwardly or downwardly about the pivot point 76. By this, the lowered

evacuating position of the dispensing head 46 can be adjusted without having to reprogramme the movement of the second stepper motor 57 and with the pin 64 out of contact with the side wall of the groove 62. To lift the head 46, the plate 60 is rotated by the stepper motor 57 so that the pin 64 eventually engages with that wall of the spiral groove 62 raising the down-stop arm 66 from a position of abutment with the arm of the lever 72. By this, the time taken by the head 46 to reach a height above a given microtitration plate 17 is independent of the setting of the evacuating position of the suction nozzles 50. This greatly simplifies the programming of the controls for the stepper motor 57.

Referring also to Figure 6, the suction bore 54 is connected with a suction pump through a solenoid operated suction valve 78 which controls the use of the suction pump. In the present embodiment the suction pump is a separate pump (not shown) located outside the apparatus but in another embodiment the suction pump is also located within the housing in the space 79.

The supply pump 80, illustrated schematically in Figure 7, comprises a piston 81 which moves in a cylinder 83. Movement of the piston 81 from left to right causes a first one-way valve 85 in the piston crown to close and fluid to be drawn in to the space vacated by and to the left of the piston 81 via a second one-way valve 89 in the left end of the cylinder 83. Once the piston 81 has travelled from left to right to the right end of the cylinder 83 and the space to the left of the piston 81 is charged with fluid, the piston returns leftwards to its original position at the left end of the cylinder 83, allowing the fluid to pass through the first one-way valve 85 in the piston 81 into the space to the right of the piston 81. Repeating the motion of the piston 81 from left to right forces the fluid in the space to the right of the piston 81 out through a third one-way valve 87 in the right end of the cylinder 83 and charges the space to the left of the piston 81 for the pumping cycle to be repeated. A solenoid surrounding the cylinder 83 is energised to move the piston 81 to and fro.

The delivery response of the pump 80 on start up is immediate. This enables the amount of fluid metered to the supply nozzles 48 to be calculated on the basis of the amount of time the pump is in operation, assuming a virtually constant rate of supply over the time. This constant supply rate is compromised, however, by the pulsating nature of the output characteristic of the pump 48. To overcome this the output of the supply pump 80 is connected with one end of a length of silicone rubber tubing 82 which has its other end connected with an adjustable restrictor valve 91. The silicone rubber tubing 82 (Fig.6) absorbs energy from the pulses of wash fluid such that, by tuning the restrictor valve 91 to the length of tubing 82, an optimum smoothness is achieved. The smoothed wash supply is connected by hardwall tubing 92 to a solenoid

operated fill control valve 84. Hardwall tubing is used to prevent pressure being trapped between the restrictor valve 91 and the solenoid valve 84 which would cause a flow surge immediately the solenoid valve 84 was opened.

The washing operation can include as many wash and rinse cycles for each row as required. These are programmed in software in a microprocessor (not shown) which issues the appropriate commands to the first and second stepper motors 36 and 57 and the solenoid valves 78 and 84.

On first switching the apparatus on, the microprocessor is programmed to cause the stepper motors 36 and 57 both to execute verification routines, each in conjunction with a corresponding microswitch.

The microswitch 90 mounted on the sleeve 23 trips when the carriage 16 has reached the end of its travel toward the rear wall 6 by means of a lever 92 abutting a stop (not shown) mounted on the wall 6. The travel of the dispensing head 46 is inhibited by a similar microswitch (not shown) which is closed when the head is fully raised.

The programme checks for the presence of a closed microswitch corresponding to the dispensing head being fully raised. If such a closure is not detected the head is raised up by a maximum of 61 steps or increments of the second stepper motor. Once again, the microswitch is interrogated for a closed state and if one is not forthcoming an error condition is indicated on a display panel and the entire wash process is inhibited. If, however, a closure is detected, the head is moved twenty steps of the second stepper motor downwardly and the microswitch is interrogated for an open circuit. Once this is detected the head is raised once more to within 10 steps of the fully raised position. The microprocessor then conducts a similar verification routine on the movement of the carriage ; if the microswitch corresponding to the carriage movement is not made the carriage is moved back a maximum of 1549 steps of the first stepper motor, while the processor surveys the microswitch to detect its closure. Once the closure is detected the carriage is moved 20 steps of the first stepper motor forward and the apparatus is ready to be programmed according to the number of rows and the nature of the wash cycle to be performed.

The number of wash routines are programmed into the microprocessing controller by means of a number of switches on a display panel 86 on a cover 88 on the housing 9. By selecting the appropriate button, the type of washing cycle can be selected, the number of times the cycle is repeated can be selected, the volume of washing fluid used for each well can be selected, soaking periods in between washing and evacuating the wells may also be programmed in.

The microprocessor offers the following mode of washing programs :

a) A normal cycle, suitable for most applications.

In this cycle the microprocessor causes each row of wells in turn to be filled with rinsing fluid and allowed to soak. After all rows have been filled the suction nozzles are lowered to the bottom of wells for each row in turn to evacuate the wells. The cycle is repeated a number of times.

b) A moving carriage cycle. This cycle is the same as the normal cycle except that during the evacuation of the wells the program follows a sub-routine whereby the carriage moves such that first one side 100 of the microplate well is moved up to the suction nozzle 50 and then the other side of the microplate well 101 is brought to the suction nozzle (see Fig. 14). Finally the carriage is moved to bring the nozzle to the centre of the well before moving on to the next row to be washed. These movements are effected by the microprocessor instructing the stepper motor 36 to move back, forth, and back again the requisite number of steps to move the plate by distances corresponding to the size of the standard microtitration well.

c) A special washing cycle to allow efficient washing of any residue at the top of the well. The apparatus is arranged so that the suction nozzles are about 2 mm above the level of the top of the microtitration plate when in the raised position (see Fig. 15). The microwell plates are over-filled while the head is in this position but suction is applied to the suction nozzle to remove any possibility of overflowing. Thus the well is washed to the top.

d) A single row washing cycle. This cycle is the same as the normal cycle except that each row is washed on all cycles before moving on to the next.

Describing the washing cycle in greater detail, with the dispensing head 46 raised, the verification routines checked and the washing mode programmed, the carriage 16 moves the microtitration plate 17 beneath the dispensing head 46 until the first row of wells programmed to be washed is aligned beneath the row of twelve nozzle pairs. The dispensing head 46 is lowered into a dispensing position such that the nozzle pairs 48,50 are above the final level of the wash fluid which is supplied to the supply nozzles 48 on a command from the microprocessor opening the solenoid operated fill control valve 84 for a given amount of time. The angle of each supply nozzle 48 with respect to the plate allows the fluid to swirl around the well as previously described, and the smoothed pump characteristic ensures that the amount of fluid metered is accurate and does not spill into adjacent wells. The force of the jet of fluid emitting from the supply nozzle 48 is arranged to be insufficient to wash off the reacted antigen/antibody adsorbed to the well wall.

After a soak period the dispensing head is low-

ered toward the wells of the plate to the evacuating position. As this is done the solenoid operated suction control valve 78 is opened to start the suction procedure before each suction nozzle 50 meets the surface of the fluid in its corresponding well. By this sequence the liquid is drawn into the suction nozzles 50 without touching, (and thereby possibly contaminating) the sides of the nozzles, as the rate of descent of the dispensing head 46 is such that the level of the fluid goes down at a rate greater than the nozzles are lowered.

It is a characteristic of the flat bottomed wells in some forms of microtitration plate that a proportion of the washing liquid remains in the corners due to surface tension. In order to minimise the amount of fluid remaining in the well and thus markedly improve the dilution of unreacted material therein, the microprocessor can be set in mode (c) to move the carriage to and fro with the head 46 in the evacuating position, allowing the suction nozzles 50 to suck up a greater amount of the fluid. Once the suction operation is performed the head 46 is raised and the wash cycle repeated in the same wells or those of the next row in the plate 14.

Each supply nozzle 48 is located beside its corresponding suction nozzle 50 in order to allow by the movement of the carriage 16, the removal of the fluid adhering to the corners of the wells without it being limited by the presence of the supply nozzles 48 and hence impair the completeness of the evacuating operation.

The spacing of each well will be the same for a given type of microtitration plate, but it is necessary to be able to finely adjust the attitude of the dispensing head 46 in the factory. This is done by loosening screws 93 securing the interconnect to the downstop 66 and setting the position in a horizontal plane. To allow the depth of movement of the suction nozzles 50 into the wells to be altered the adjustment lever is used as previously described. The depth of such wells may vary according to the nature of the plate used ; if the bottom was not flat the shuffling backwardly and forwardly of the suction nozzles 50 would be reduced and the working depth of the suction nozzles 50 changed accordingly.

Claims

1. Microtitration plate washing apparatus comprising washing liquid supply nozzles (48) and suction nozzles (50), the nozzles (48, 50) being mounted on a vertically moveable head (46) in a row of pairs of nozzles, the row having the pairs of nozzles spaced at the spacing of the wells in a row of wells in a microtitration plate (14) to be washed by the apparatus, each pair of nozzles comprising one supply nozzle (48) and one suction nozzle (50) mounted sufficiently

close together that both nozzles in the pair can be simultaneously placed into a single well in the microtitration plate (14) upon lowering of the head (46) by a head-moving mechanism (57-64) within the apparatus, wherein the supply nozzles (48) are connected to a source of wash fluid (80) through a supply control valve (84) and the suction nozzles (50) are connected to a vacuum source through a suction control valve (78), characterised in that the apparatus further comprises a horizontally movable microtitration plate support (16), support moving means (36, 28) for horizontally moving the plate support (16) under the control of a microprocessor to bring a selected row of wells beneath the nozzles (48, 50) and for selectively moving the plate support (16) when the head (46) is lowered to cause the suction nozzles (50) to traverse the bottoms of the selected row of wells, and in that the supply nozzle (48) of each pair of nozzles is sufficiently shorter than the suction nozzle (50) as not to hinder the suction nozzles (50) traversing the bottoms of the selected row of wells, the microprocessor means also being operable to open the supply control valve (84) for a given period of time to fill the wells, dwell for a soak period, and then open the suction control valve (78) on lowering the head (46) at a rate sufficiently low in relation to the rate of suction that fluid in the wells is sucked out of the wells without the suction nozzles (50) being immersed in the fluid in the wells.

2. Apparatus as claimed in claim 1, characterised in that the microprocessor is operable to cause the support moving means (36, 28) to move the plate support (16) horizontally to bring a selected row of wells on the microtitration plate (14) under the row of nozzles (48, 50), operate the head moving mechanism (57-64) to lower the head (46) to bring the suction nozzles (50) a short distance above the level of the top of the microtitration plate (14), and simultaneously open the supply control valve (84) and the suction control valve (78) such that the wells in the selected row of wells are over-filled without overflowing whereby the tops of the wells are washed prior to draining the wells.

Ansprüche

1. Waschvorrichtung für Mikrotitrierplatten, bestehend aus Lieferröhen (48) für eine Waschflüssigkeit und Absaugdüsen (50), wobei diese Düsen (48, 50) in einer Reihe von Düsenpaaren an einem vertikal beweglichen Kopf (46) montiert sind und diese Reihe die Düsenpaare mit dem Abstand der Quellen einer Quellenreihe in einer durch die Vorrichtung zu waschenden Mikrotitrierplatte (14) beabstandet aufweist, wobei jedes Düsenpaar eine Lieferdüse (48) und eine Absaugdüse (50) umfaßt, welche derart genügend eng montiert sind, daß beide Düsen jedes

Paares gleichzeitig in einer einzigen Quelle der Mikrotitrationsplatte (14) positioniert werden können, wenn der Kopf (46) innerhalb der Vorrichtung durch einen Kopf-Bewegungsmechanismus (58 bis 64) abgesenkt wird, und wobei die Lieferdüsen (48) über ein Liefer-Steuerventil (84) mit einer Lieferquelle (80) für die Waschflüssigkeit und die Absaugdüsen (50) über ein Absaug-Steuerventil (78) mit einer Vakuumlieferquelle verbunden sind, dadurch **gekennzeichnet**, daß die Vorrichtung noch einen horizontal beweglichen Träger (16) für die Mikrotitrationsplatten sowie eine Träger-Bewegungseinrichtung (36, 28) für ein horizontales Bewegen des Plattenträgers (16) unter der Kontrolle eines Mikroprozessors umfaßt, um eine ausgewählte Quellenreihe unterhalb der Düsen (48, 50) zu positionieren und um den Plattenträger (16) wahlweise zu bewegen, wenn der Kopf (46) abgesenkt wird, damit die Absaugdüsen (50) die Böden der ausgewählten Quellenreihe überqueren können, und daß die Lieferdüse (48) jedes Düsenpaares genügend kürzer als die Absaugdüse (50) ist, damit die Absaugdüsen nicht am Überqueren der Böden der ausgewählten Quellenreihe behindert werden, wobei der Mikroprozessor auch dafür eingerichtet ist, das Liefer-Steuerventil (84) für ein Füllen der Quellen über eine vorbestimmte Zeitdauer zu öffnen, eine Verweilzeit über eine Einweichdauer zu erhalten und das Absaug-Steuerventil (78) beim Absenken des Kopfes (46) mit einer genügend langsamen Rate im Vergleich zu der Absaugrate zu öffnen, so daß die Flüssigkeit in den Quellen aus diesen Quellen abgesaugt wird, ohne daß die Absaugdüsen (50) in die Flüssigkeit in den Quellen eingetaucht wird.

2. Vorrichtung nach Anspruch 1, dadurch **gekennzeichnet**, daß der Mikroprozessor dafür eingerichtet ist, die Träger-Bewegungseinrichtung (36, 28), für eine horizontale Bewegung des Plattenträgers (16) zu betätigen, damit eine ausgewählte Quellenreihe an der Mikrotitrationsplatte (14) unterhalb der Reihe der Düsen (48, 50) positioniert wird, den Kopf-Bewegungsmechanismus (57 bis 64) für ein Absenken des Kopfes (46) zu betätigen, damit die Absaugdüsen (50) mit einem kurzen Abstand oberhalb der Ebene der oberen Begrenzung der Mikrotitrationsplatte (14) positioniert werden, und gleichzeitig das Liefer-Steuerventil (84) und das Absaug-Steuerventil (78) zu öffnen, so daß die Quellen in der ausgewählten Quellenreihe überfüllt werden, ohne daß es zu einem Überlaufen kommt und dadurch die Oberseiten der Quellen gewaschen werden, noch bevor die Quellen entleert werden.

Revendications

1. Appareil de lavage pour plaque de microdosage comprenant des buses d'alimentation (48) en liquide de lavage et des buses de succion (50), les

buses (48, 50) étant montées sur une tête (46) mobile verticalement sous forme d'une rangée de paires de buses, la rangée ayant les paires de buses espacées selon l'espacement des puits dans une rangée de puits d'une plaque de microdosage (14) à laver par l'appareil, chaque paire de buses comprenant une buse d'alimentation (48) et une buse de succion (50) montées suffisamment près l'une de l'autre de façon que l'une et l'autre des buses d'une paire peuvent être simultanément introduites dans un même puits de la plaque de microdosage (14) lorsque la tête (46) est abaissée par le mécanisme d'actionnement de tête (57-64) à l'intérieur de l'appareil, dans lequel les buses d'alimentation (48) sont connectées à une source de fluide de lavage (80) par l'intermédiaire d'une vanne de commande d'alimentation (84) et les buses de succion (50) sont connectées à une source de vide par l'intermédiaire d'une vanne de commande de succion (78), caractérisé en ce que l'appareil comprend en outre un support (16) de plaque de microdosage mobile horizontalement, des moyens de déplacement de support (36, 28) pour déplacer horizontalement le support de plaque (16) sous le contrôle d'un microprocesseur pour amener une rangée sélectionnée de puits au-dessous des buses (48, 50) et pour déplacer sélectivement le support de plaque (16) lorsque la tête (46) est abaissée pour faire traverser par les buses de succion (50) les fonds des rangées sélectionnées de puits, et en ce que la buse d'alimentation (48) de chaque paire de buses est suffisamment plus courte que la buse de succion (50) pour ne pas empêcher que les buses de succion (50) traversent les fonds des rangées sélectionnées de puits, le moyen de microprocesseur étant également actionnable pour ouvrir la vanne de commande d'alimentation (84) pendant une durée déterminée pour remplir les puits, pour assurer le maintien pendant une période de trempage, et ensuite pour ouvrir la vanne de commande de succion (78) lors de l'abaissement de la tête (46) selon un taux suffisamment bas par rapport au taux de succion pour que le fluide dans les puits soit extrait des puits sans que les buses de succion (50) soient immergées dans le fluide présent dans les puits.

2. Appareil selon la revendication 1, caractérisé en ce que le microprocesseur est actionnable pour que le moyen de déplacement de support (36, 28) déplace le support de plaque (16) horizontalement pour amener une rangée sélectionnée de puits sur la plaque de microdosage (14) au-dessous d'une rangée de buses (48, 50), pour actionner le mécanisme de déplacement de tête (57-64) pour abaisser la tête (46) et amener les buses de succion (50) à une courte distance au-dessus du niveau du sommet de la plaque de microdosage (14), et pour ouvrir simultanément la vanne de commande d'alimentation (84) et la vanne de commande de succion (78) de telle façon que les puits dans les rangées sélectionnées de puits

soient remplis entièrement sans débordement de sorte que les sommets des puits sont nettoyés avant le vidage des puits.

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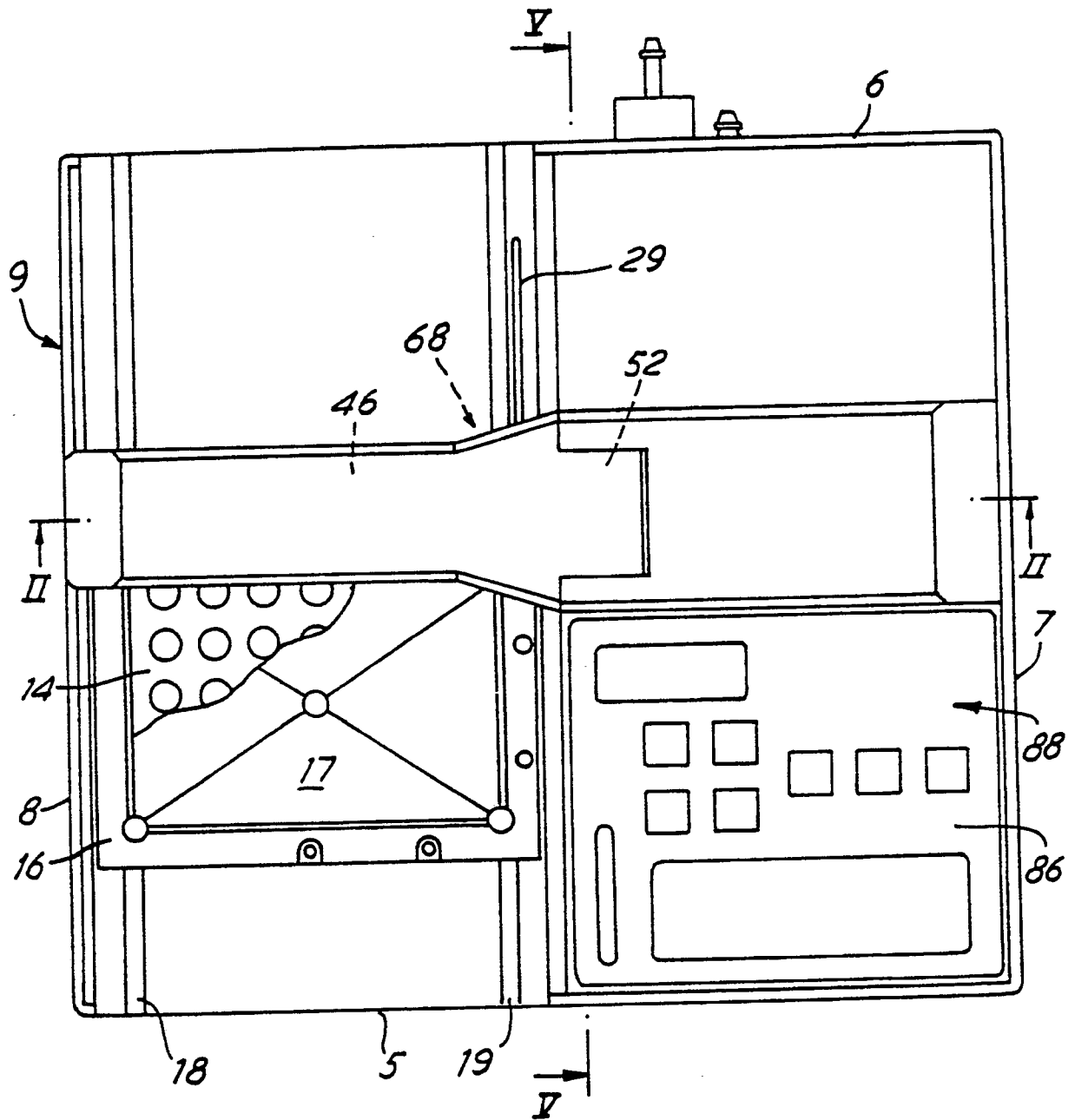
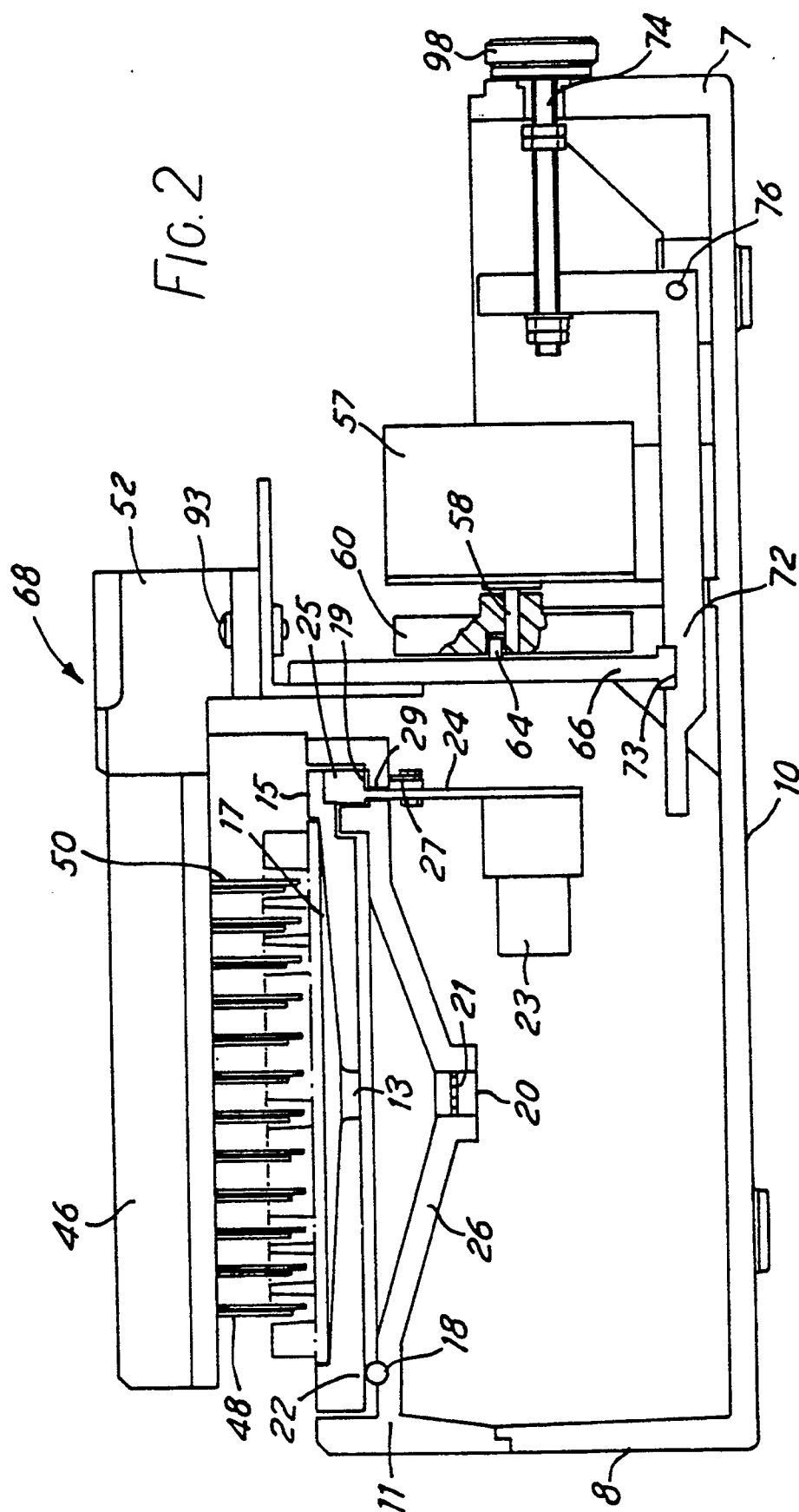


FIG. 1



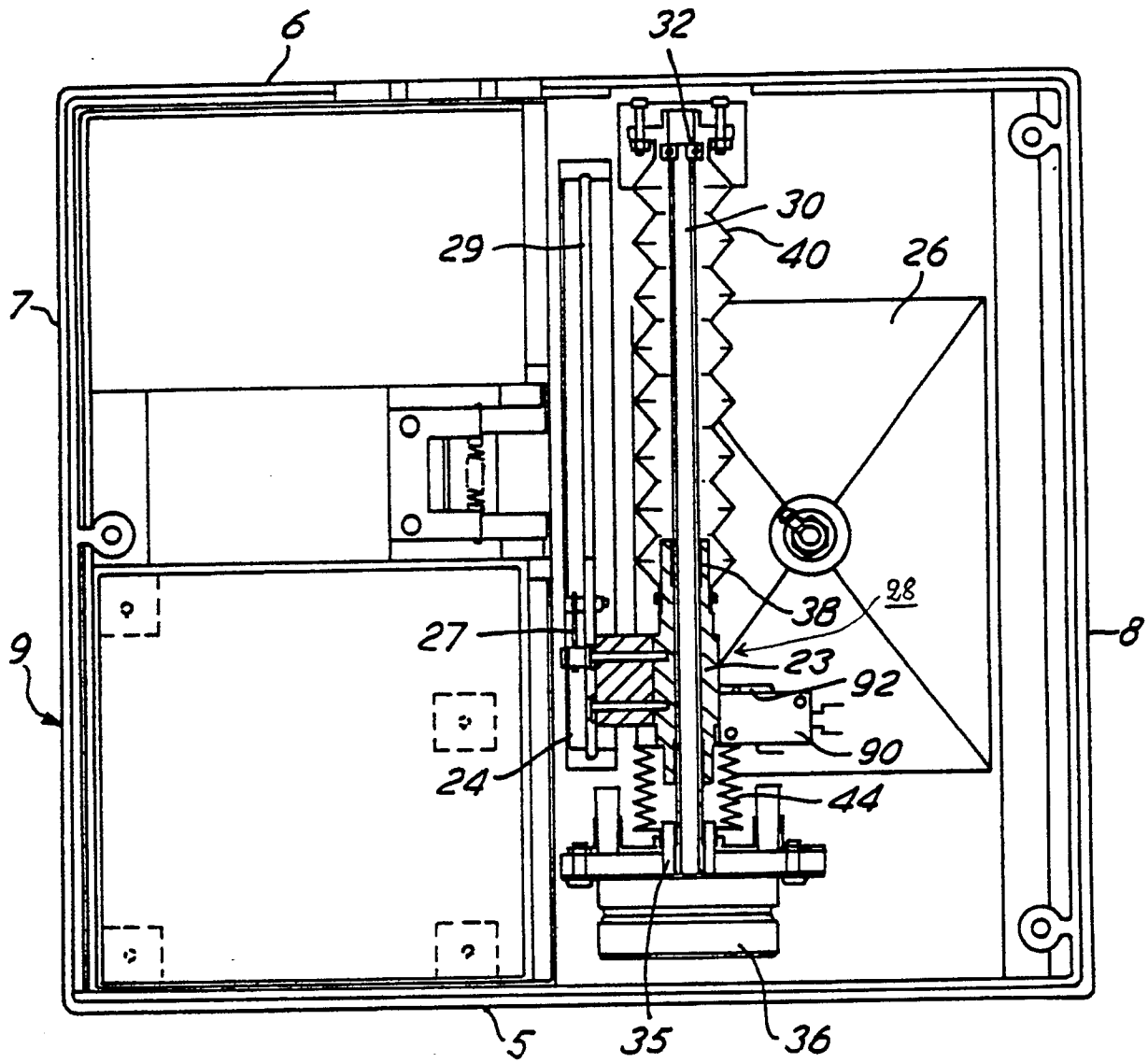
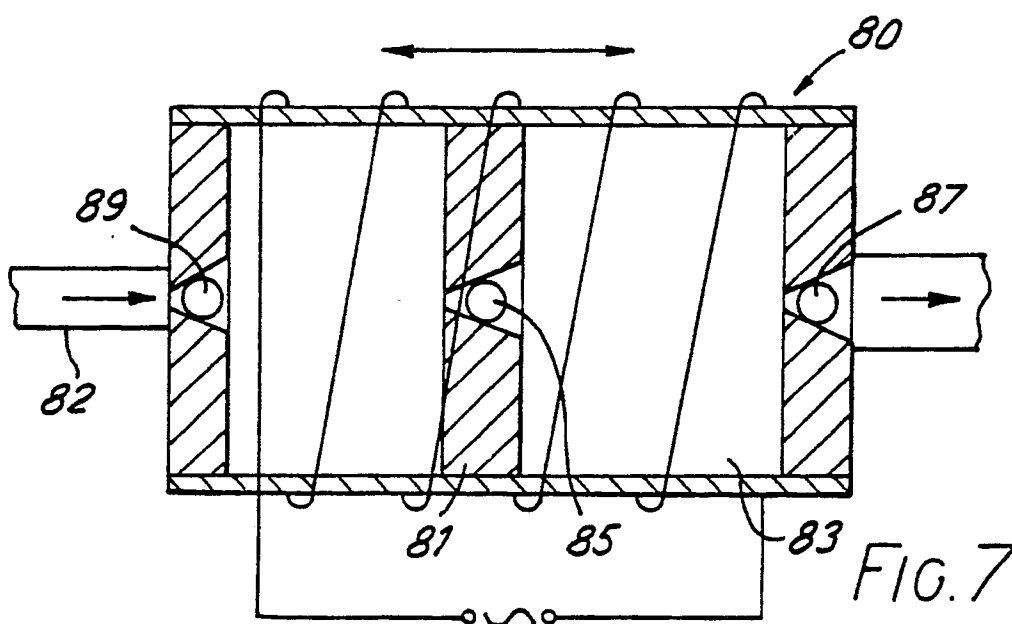
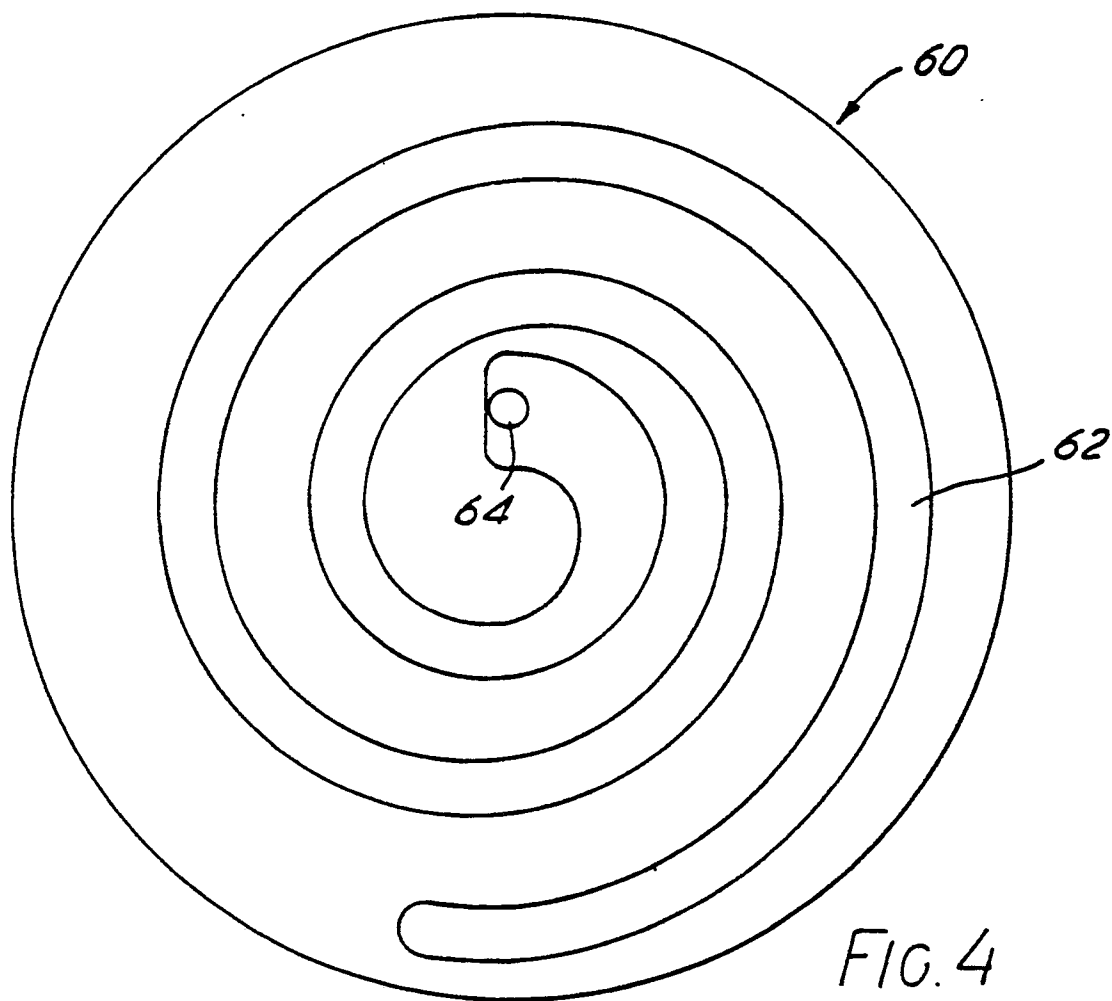
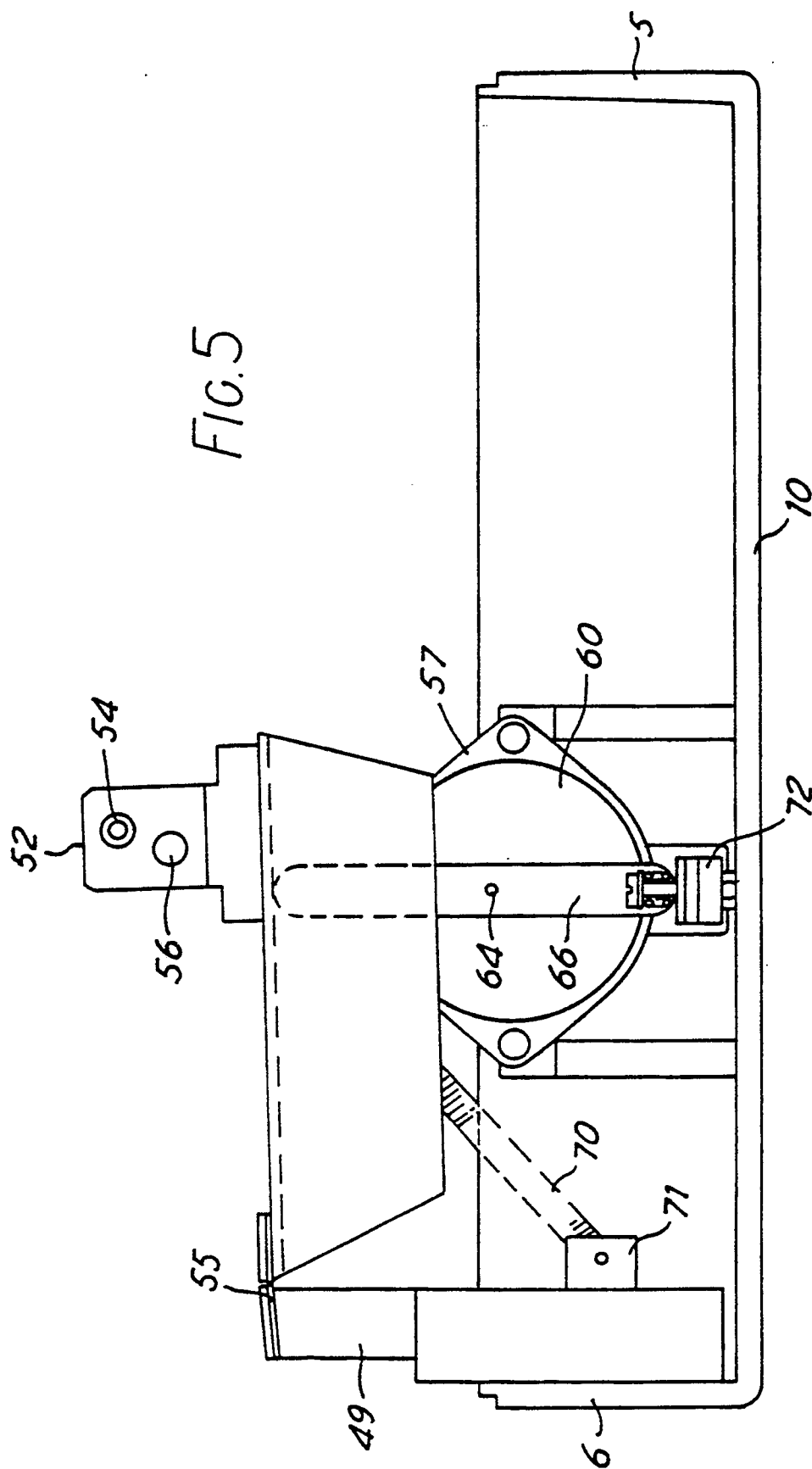


FIG. 3





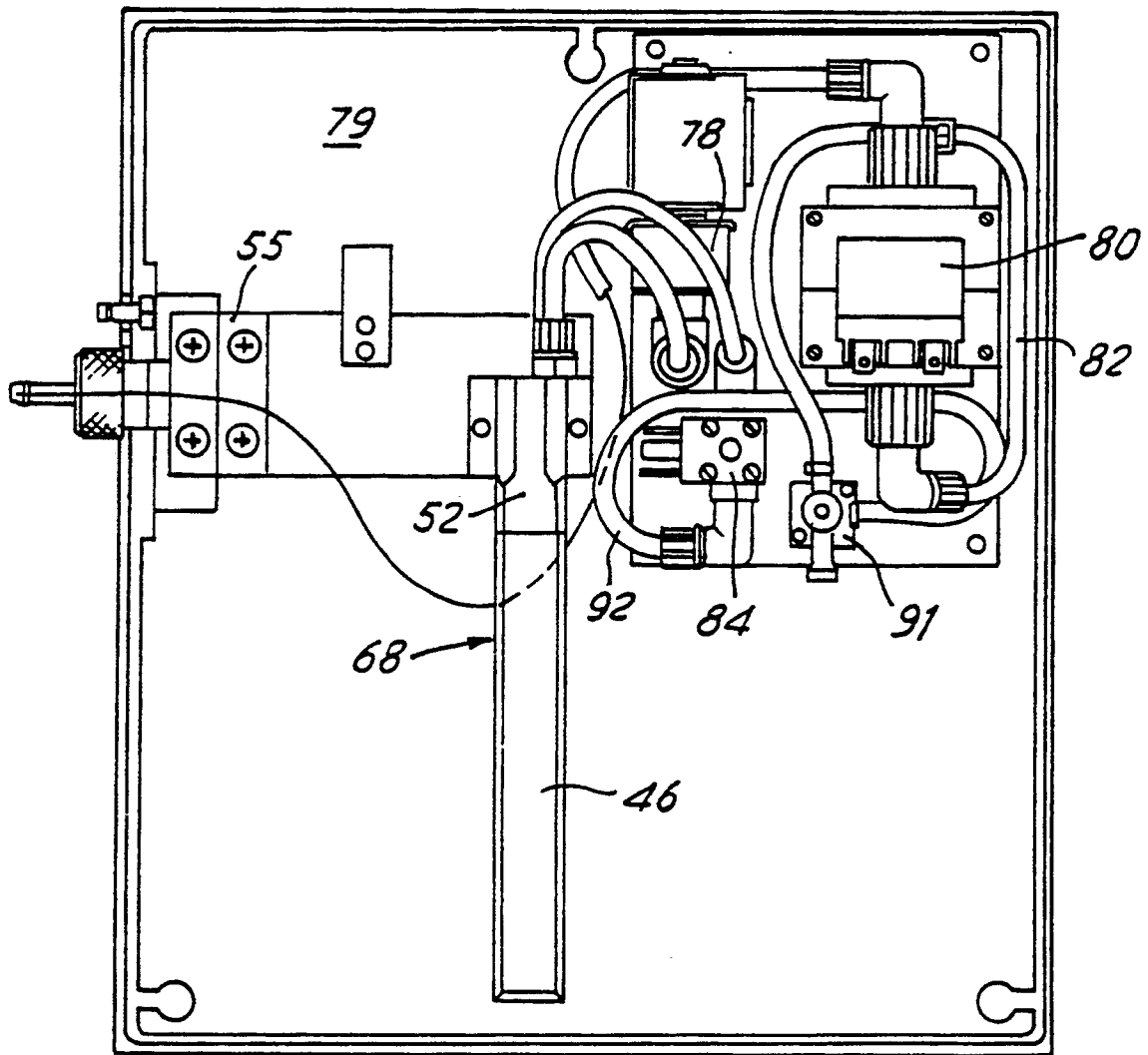


FIG. 6

