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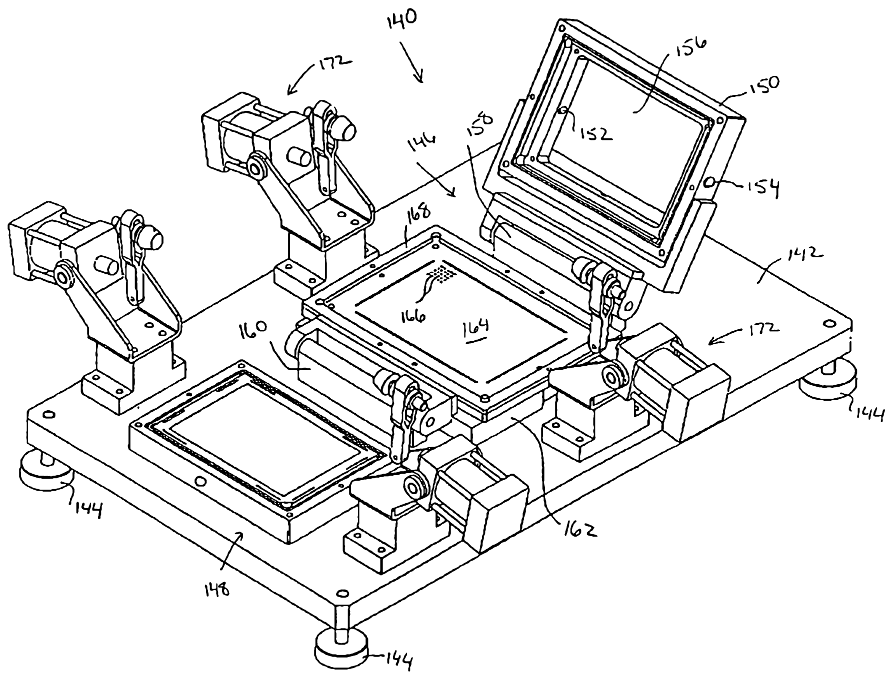

(57) **Abstract:** A device and method for distributing solid supports has a flow system (150), an attraction device (162), and a receiver (148). The flow system (150) is positioned over the attraction device (162) where particles are attracted into holes (166) in an attraction surface (164) using vacuum. The flow system (150) is removed and the attraction device (162) is positioned over the receiver (148) and the particles transferred to the receiver (148) by pressure and/or vacuum.

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SYSTEMS AND METHODS FOR DISTRIBUTING AND TRANSFERRING BEADS

BACKGROUND OF THE INVENTION

This invention relates generally to the management of solid supports, and in particular to the management of solid supports, such as beads, onto which various chemicals have been synthesized. More particularly, the invention relates to the organization of such solid supports to facilitate the evaluation of the synthesized chemicals.

The creation of large chemical libraries has become of vast importance to modern chemistry. By creating large, diverse chemical libraries, the chances of identifying certain chemical compounds is greatly enhanced. One exemplary way to produce such libraries is by utilizing solid supports onto which the chemicals are synthesized. Conveniently, the solid supports serve as a transport device to facilitate movement of the chemicals. Further, the solid supports allow for the release of the synthesized chemicals on demand, such as when performing assays on the chemicals.

A variety of processes and techniques have been employed to synthesize chemicals onto solid supports and are well known within the art. Merely by way of example, one such process is described in U.S. Patent No. 5,503,805, the complete disclosure of which is herein incorporated by reference.

To facilitate the analysis of the chemicals synthesized onto the solid supports, in some cases it may be desirable to separate the solid supports. In some cases, it may further be desirable to organize the solid supports to facilitate testing using one or more assays. For example, one type of assay that may be employed is a lawn assay where solid supports are suspended in an agarose solution and then poured onto a plate containing cells. Once the agarose has solidified, the chemicals are released, e.g., using UV light, and a layer of bacteria may be placed over the solid supports. The solid supports producing a desirable response may the be identified and removed. Other types of assays where the solid supports may be separated and/or organized are direct binding assays, solution assays, and the like as is known in the art.

Exemplary techniques for separating and/or organizing solid supports are described in PCT Publication Number WO 97/40383, the complete disclosure of which is herein incorporated by reference. Even so, it would be desirable to provide other ways to distribute, separate, and/or organize solid supports to facilitate evaluation of the synthesized chemicals. In this way, the time and effort required to manually separate and organize such solid supports may be greatly reduced.

SUMMARY OF THE INVENTION

The invention provides systems, devices and methods to distribute and/or organize solid supports that are held within a suspension medium. In some embodiments, the invention also provides for the transfer of the solid supports in an organized manner. In one particular embodiment, the invention provides a device for distributing solid supports that comprises an attraction surface and a flow system to flow a suspension medium containing solid supports across the attraction surface to permit at least some of the solid supports to be distributed on the attraction surface in an organized array. Conveniently, the flow system may be configured to be removably positioned over the attraction surface so that the flow system may be moved to provide access to the attraction surface after the solid supports have been attracted in the organized array.

In one aspect, the attraction surface comprises a plate or membrane having an array of holes. A vacuum source may conveniently be provided to create a vacuum at the holes in the attraction surface to suction the flowing solid supports into the holes. Preferably, the holes are sized to be smaller than the solid supports so that the solid supports will be prevented from flowing through the holes. In another aspect, a manifold may be provided and coupled about the membrane. In this way, the vacuum source may be placed in communication with the manifold to produce the vacuum at each of the holes.

In another particular aspect, the flow system comprises a housing that defines a chamber and includes an inlet and an outlet to permit the suspension medium to be moved through the chamber. Conveniently, a gasket may be disposed about the attraction surface to form a seal during assembly. Optionally, a clamp may be provided to secure the housing to the gasket.

In another embodiment, the invention provides a device for transferring solid supports. The device comprises an attraction surface having an array of holes that are each adapted to receive a solid support. A plate is also provided having a plurality of wells that each include a hole. The plate may be operably coupled to a vacuum source to draw the solid supports from the attraction surface and into the wells. For example, the attraction surface may be positioned above the plate, and the vacuum source actuated to draw the solid supports from the attraction surface and into the wells.

Conveniently, a manifold may be coupled to the plate. In this manner, the vacuum may be applied to the manifold so that suction is provided through the holes in each of the wells. Optionally, a pressure source may be employed to supply pressure to the attraction surface to force the solid supports from the holes.

In another particular embodiment, the invention provides a system for distributing and transferring solid supports. The system comprises a distribution device for producing a flowing stream of solid supports held within a suspension medium and to distribute at least some of the solid supports into an organized array. A transfer device is also provided to transfer at least some of the distributed solid supports to an acceptor member in an organized manner.

In one aspect of the system, an attraction surface is provided for receiving the solid supports in the organized array. Conveniently, the attraction surface may be shared by both the distribution device and the transfer device. In another aspect, the attraction surface comprises a membrane having an array of holes for receiving the solid supports. A vacuum source is provided to produce a vacuum at the attraction surface to attract the solid supports to the holes in the attraction surface. Optionally, a pressure source may be provided to force the solid supports from the membrane and to the acceptor member.

In still another embodiment, the invention provides a system for distributing and transferring solid supports. The system comprises an attraction surface and a flow system for flowing a suspension medium containing solid supports across the attraction surface to permit at least some of the solid supports to be attracted to the attraction surface in an organized array. A transfer system is provided to transfer at least some of the solid supports from the attraction surface in an organized array.

In one aspect, the system further comprises a base member, with the attraction surface, the flow system and the transfer system being operably coupled to the base member. Optionally, the attraction surface and the flow system may be pivotally coupled to the base member to permit the flow system to be pivoted over the attraction surface when flowing the suspension medium across the attraction surface. The attraction surface may then be pivoted over at least a portion of the transfer system when transferring the solid supports in the organized array.

In one particular aspect, the flow system comprises a housing defining a chamber and includes an inlet and an outlet to permit the suspension medium to be moved through the chamber. Conveniently, the attraction surface may comprise a membrane having an array of holes that is positioned adjacent a gasket. In this way, a clamp may be employed to secure the housing of the flow system to the gasket to provide a sealed, closed system. In a similar manner, a manifold may be positioned adjacent the gasket and a vacuum source coupled to the manifold to attract the solid supports into the holes. Optionally, a pressure source may also be coupled to the manifold to force the solid supports from the holes when transferring the solid supports.

In one particular aspect, the transfer system may further comprise a plate having a plurality of wells that each include a hole. The wells may be configured to be aligned with the holes of the membrane when the membrane is placed over the plate. In this way, a vacuum may be provided through the holes of the wells and/or pressure supplied to a backside of the membrane to transfer the solid supports from the membrane and into the wells.

The invention also provides an exemplary method for arraying solid supports. According to the method, a suspension of solid supports is flowed over an attraction surface. At least some of the solid supports are attracted to the attraction surface such that the attracted solid supports are organized into an array on the attraction surface.

In one aspect, the attraction surface may include an array of holes, and a vacuum may be applied to the holes while the suspension is flowing over the attraction surface. In one optional aspect, assays may be performed on compounds disposed on the solid supports after the solid supports are arrayed on the attraction surface. In another aspect, a liquid may be flowed across the attraction surface to remove excess solid supports from the attraction surface.

The invention further provides a method for distributing and transferring solid supports. According to the method, a suspension medium is flowed over an attraction surface. The suspension medium contains solid supports. At least some of the solid supports are attracted to the attraction surface in an organized array. At least some of the solid supports are then attracted from the attraction surface to an acceptor member in an organized manner.

For example, the acceptor member may include an array of wells to permit the solid supports to be suctioned from the attraction surface into the wells. Conveniently, the wells may be provided with holes to facilitate the creation of the vacuum within the wells. In a similar manner, the attraction surface may include holes so that a vacuum may be drawn through the holes in the wells in the attraction surface to attract the solid supports into the holes. Conveniently, the attraction surface may be coupled to a base member and then pivoted over the acceptor member after the solid supports have been attracted to the attraction surface.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram of one embodiment of a device for distributing and organizing solid supports according to the invention.

Fig. 2 is a schematic diagram of one system that may be employed to distribute and organize solid supports according to the invention.

Fig. 3 is a top perspective view of one exemplary embodiment of a device for distributing and organizing solid supports according to the invention.

Fig. 4 illustrates the device of Fig. 3 in an operational mode where solid supports are being distributed and organized.

Fig. 5 is a schematic diagram illustrating one method for performing an assay on solid supports that have been organized onto a membrane according to the invention.

Fig. 6 is a top perspective view of one embodiment of a system for distributing and transferring solid supports in an organized manner according to the invention.

Fig. 7 illustrates the system of Fig. 6 when distributing and organizing solid supports.

Fig. 8 illustrates the system of Fig. 8 when transferring solid supports that have previously been arrayed.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

The invention provides for the distribution and organization of solid supports. When distributing the solid supports, the invention is preferably configured to organize the solid supports in a spaced apart manner to facilitate the performance of assays and/or to facilitate further handling of the solid supports. In some embodiments, the invention further provides for the transfer of the solid supports to another location or device while maintaining the organization of the solid supports.

In one aspect of the invention, the solid supports comprise small, relatively spherical beads. The beads are typically on the order of about 5 μm to about 300 μm in diameter, and more usually from about 80 μm to about 200 μm. The beads may conveniently be constructed of a polymer, such as a polystyrene and polyethylene glycol, and are commercially available from a variety of suppliers, such as, for example, Nova BioChem. Typically, one or more chemicals will be synthesized onto the solid supports using processes known in the art.

For a variety of reasons, such as to facilitate handling of the solid supports, it is usually desirable to process the solid supports within a suspension medium. The solid supports of the invention may be disposed within a wide variety of such suspension media, including water, water solutions, ethanol, solvents, and the like. As described hereinafter, one particular advantage of the invention is the ability to separate and organize the solid supports while they are suspended within such media.

Followings synthesis of the chemicals onto the solid supports, it is typically desirable to evaluate the synthesized chemicals. As such, a wide variety of assays may be performed on the solid supports. For example, assays that may be employed to evaluate the chemicals include lawn assays, solution assays, direct binding assays, and the like. To perform such assays, it is usually desirable to separate the solid supports from each other and to arrange the solid supports in some type of organized manner, such as in a two-dimensional array. Accordingly, in one aspect of the invention, the solid supports are distributed and organized by provided an attraction surface over which a suspension medium containing solid supports is flowed. The solid supports are then attracted to various locations on the attraction surface such that they are spaced apart and organized in some fashion. For example, the attraction surface may comprise a plate or membrane having an array of holes. A vacuum may be provided at the holes to attract the solid supports into the holes as the suspension medium is flowed across the plate or membrane. Alternatively, the suspension medium may be supplied from a fixed location while moving the plate or membrane to permit the solid supports to be distributed over the plate or membrane.

As another alternative, the plate or membrane may be provided with grooves or wells to facilitate the capture of the solid supports. In some cases, the membrane may be configured to be a continuous sheet with regions through which a liquid may be flowed upon application of a vacuum. In this way, the membrane would not need to include holes. As yet another alternative, the attraction surface may include various regions that are treated with a magnetic substance, and the supports may include a material that is attracted to the magnetic areas as the solid supports are flowed across the attraction surface.

In another aspect, the distribution devices or systems of the invention may be employed to be either open systems or closed systems. For example, the attraction surface may be covered with a housing through which the suspension medium is flowed. Alternatively, the attraction surface may be open to atmospheric pressure while the suspension medium is flowed across the attraction surface. In another aspect, a variety of techniques may be employed to flow the solid supports across the attraction surface. For example, a liquid may be flowed across the attraction surface and the solid supports injected into the flowing stream. As another alternative, the solid supports may be injected into a stream of liquid at the same time the stream is first being introduced to the attraction surface. As another alternative, a liquid may be disposed on top of the attraction surface and the solid supports injected into the standing liquid. Additional liquid may then be employed to push the solid supports across the attraction surface.

To move the suspension medium and solid supports across the attraction surface, a vacuum may be employed to create a vacuum parallel to the attraction surface. Also, a vacuum created underneath the attraction surface may be employed to assist in flowing the solid supports across the attraction surface when the attraction surface includes holes for receiving the solid supports. As the solid supports begin to fill the holes in the attraction surface, a stronger vacuum is created in the empty holes, thereby facilitating complete filling of the holes of the attraction surface.

Once the solid supports have been organized onto the attraction surface, assays may be performed while the solid supports remain on the attraction surface, or the solid supports may be transferred to another location where the assay are performed. For example, with lawn assays the chemicals may be released from the solid supports while they remain on the attraction surface.

To transfer the solid supports from the attraction surface to other locations, a variety of techniques may be employed. For example, the attraction surface may be placed upside down over a plate having a plurality of wells so that the solid supports may be transferred into the wells. Conveniently, a pressure source may be employed to expel the solid supports from the attraction surface and into the wells. In some cases, the wells may include a capillary hole to permit a vacuum to be drawn through the wells and to thereby attract the solid supports from the attraction surface and into the wells. Examples of multi-well plates having capillary holes that may be employed are described in co-pending U.S. Application Serial No. 08/887,141, filed July 2, 1997, the complete disclosures of which are herein incorporated by reference. Conveniently, the wells of the plate may be configured to be directly aligned with the holes in the attraction surface so that the solid supports are transferred into the wells in a one-to-one relationship. Alternatively, multiple holes of the attraction surface may be aligned with a single well so that multiple solid supports are transferred into a single well.

As an alternative to using a pressure or vacuum source to transfer the solid supports, a sheet material or membrane may be provided with a sticky surface which is placed against the solid supports. The sheet may then be removed to transfer the solid supports. Such an arrangement may be particularly useful when the attraction surface does not include holes through which a vacuum or positive pressure may be applied.

Hence, the invention provides techniques for distributing and organizing solid supports in an automated manner. In this way, significant time and labor may be saved in attempting to separate and organize the solid supports. Further, by being able to separate and organize a solid support in this manner, transfer of the solid supports is facilitated. For example, large numbers of solid supports may be transferred at one time into individual wells. Hence, plates having large numbers of wells, *e.g.*, 96 wells, 864 wells, 1296 wells and the like may rapidly be filled with a single solid support or multiple solid supports per well.

Referring now to Fig. 1, one embodiment of a bead distribution system 10 will be described. System 10 comprises a bead distribution device 12 that is constructed of a housing 14 that holds a membrane 16. As shown, housing 14 is open to the atmosphere to provide an open system. Alternatively, housing 14 could be closed to provide a closed system. Membrane 16 includes a plurality of holes 18 that are conveniently arranged in a two-dimensional array. Preferably, the holes are spaced apart by a distance sufficient to maintain the beads separated when they are attracted over each of the holes. Holes 18 generated on membrane 16 are cone shaped, and perforated openings on the bottom of the holes have a dimension that is about 60% to about 80% of the bead diameter. In this way, a sufficient vacuum force may be drawn through each of the holes, with the holes being small enough to prevent the beads from being sucked through membrane 16 upon application of the vacuum.

System 10 further includes a liquid source 20 to which is coupled a line 22. Disposed in line 22 is a port 24 for injecting beads into line 22. Downstream of port 24 is a flow regulation valve 26. Downstream of valve 26 is a manifold 28 which divides the flow of liquid into multiple channels 30. Liquid source 20 is coupled to pressure source 32 so that when valve 26 is opened a supply of liquid is distributed into each of channels 30 where it flows through housing 14 and across membrane 16. As shown, beads are injected into ports 24 and flowed through channels 30 so that they may be distributed over membrane 16.

A variety of liquids may be used for liquid source 20 including water, sucrose-water solutions, ethanol and the like. Also, the beads will typically suspended in a liquid when injected into ports 24. Examples of liquids that may be employed to store the solid supports include water, sucrose-water solutions, ethanol, agarose solutions and the like.

A vacuum source (not shown) is coupled to a line 34 having a valve 36. When valve 36 is opened, a vacuum is created at each of holes 18 in membrane 16. Another vacuum source (not shown) may be coupled to a line 38 having a valve 40 to assist in maintaining a continuous laminar flow of the liquid and beads across membrane 16. As shown, excess beads are drawn from housing 14 and exit system through line 38.

Hence, during operation, a continuous flow of beads suspended in liquid are flowed across membrane 16. When valve 36 is opened, beads are drawn into holes 18 of membrane 16, with the vacuum forces maintaining the beads within their holes. The suspended beads are flowed across membrane 16 until essentially all of the holes are filled with a bead.

Referring now to Fig. 2, an alternative embodiment of a bead distribution system 42 will be described. System 42 comprise a bead distribution device 44. Device comprises a housing 46 that holds a membrane 48 having a plurality of holes 50. System 42 further includes a liquid source 52 which is under pressure. A flow regulation valve 54 may then be opened to create a flow of liquid across membrane 48.

System 42 also includes a bead source 56 which includes a plurality of beads 58 that are suspended in a suspension medium 60. A line 62 couples bead source 56 to a distribution manifold 64. Also, a valve 66 is disposed in line 62. Bead source 56 is further coupled to a valve 68 that may be operated to vent bead source 56 or apply positive pressure to bead source 56. In this way, when valve 68 is set to apply positive pressure to bead source 56 (and valve 66 is open), beads will flow through manifold 64 and be deposited on membrane 48. Housing 46 may be moved back and forth as shown by the arrows to permit membrane 48 to be completely covered with suspension medium 60 which contains beads 58. Alternatively, manifold 64 may be moved back and forth over membrane 48.

A vacuum is also applied to the underside of membrane 48 as illustrated by arrow 70. In this way, beads 58 will be suctioned into holes 50. To draw off any excess beads, valve 54 is opened to permit liquid from source 52 to flow across membrane 48. Excess liquid and beads then exit housing 46 through an opening 72 where they pass into a bead recovery unit 74. The beads may then be transferred back into bead source 56 where they may be recirculated through system 42.

If all of holes 50 do not receive a bead, additional beads may be supplied from bead source 56 as previously described. Valve 54 may then be opened to wash off any excess beads as just described. This process may be repeated as many times as needed in order to completely fill holes 50.

Referring now to Fig. 3, one exemplary embodiment of a bead distribution device 76 will be described. Device 76 comprises a base 78 that may optionally be provided with multiple legs 80. Coupled to base 78 is a manifold 82 having a vacuum port 84 to permit manifold 82 to be coupled to a vacuum source as illustrated by arrow 86.

Disposed across manifold 82 is a membrane 88 that includes an array of holes (not shown). A resilient gasket 90 is positioned on manifold 82. Conveniently, membrane 88 may be positioned on top of, or underneath gasket 90, and may be supported by a metal mesh (not shown).

Also coupled to base 78 are a pair of brackets 94. Pivotally coupled to brackets 94 by bolts 96 is a plate 98. Coupled to plate 98 is a housing 100 having an inlet port 102 and an outlet port 104. In this way, a suspension medium containing beads may be introduced into inlet port 102 where it will flow through housing 100 and exit outlet port 104 as shown by arrows 106 and 108.

A resilient gasket 110 is positioned on housing 100 to provide a seal with gasket 90 when plate 98 is pivoted to place housing 100 over membrane 88 as illustrated in Fig. 4. Alignment pins 92 align manifold 82 with gaskets 90 and 110 and housing 100. Conveniently, a handle 112 is coupled to plate 98 to facilitate pivoting of housing 100 over membrane 88.

When housing 100 rests upon gasket 90, a cavity is formed between membrane 88 and the interior of housing 100. In this way, a suspension medium containing beads may be flowed through the cavity while a vacuum is being supplied to vacuum port 84 to attract the flowing solid supports to the holes in membrane 88. Optionally, a window 114 may be provided in plate 98 as illustrated in Fig. 4 to permit visual inspection inside the cavity when the beads are flowing through the cavity.

Also coupled to base 78 are a pair of blocks 116. Coupled to blocks 116 are pneumatic clamps 118. Clamps 118 each comprise a frame 120 to which an arm 122 is pivotally coupled. An adjustable stop 124 is coupled to each arm 122. Once plate 98 is moved to the operating position shown in Fig. 4, arms 122 are pivoted downward until stops 124 rest on plate 98. Stops 124 may be adjusted so that arms 22 are generally parallel with base 98. Pneumatic cylinders 126 are then actuated to force a cylinder 128 against arms 122 to clamp housing 100 against gasket 90. Exemplary pneumatic clamps that may be used include pneumatic power clamps, commercially available from De-Sta-Co, a division of Dover Corporation.

In one mode of operation, liquid and beads are introduced under pressure into inlet port 102. A vacuum is applied to port 84 to suction the beads to the holes in membrane 88 as previously described. Optionally, a vacuum may be provided at outlet 104 to assist in the flow of liquid and/or beads across membrane 88. A variety of other techniques may be employed to distribute the beads across membrane 88 and to suction the beads into the holes. As one example, a liquid which does not include beads may be introduced into inlet 102 while the vacuum to port 84 is off and the vacuum at port 104 is on. Beads may then be injected into a pressurized flow of liquid which enters into inlet 102 while the vacuum at port 84 is turned on and the vacuum at outlet 104 is turned off.

As another example, the vacuum at port 84 and at outlet port 104 may both be turned on and a pressurized liquid that does not include beads may be introduced into inlet 102. In this way, a stream of liquid is flowed across membrane 88. The beads may then be injected into inlet 102 where the liquid stream will move the beads from one side of the membrane to the other side.

In still another example, the membrane may be configured to initially be free of liquid. The vacuum at port 84 is then turned on while vacuum at outlet 104 is off. A liquid is then permitted to flow through inlet 102 and shortly thereafter beads may be introduced into the liquid. Preferably, the beads are injected into the liquid before the flowing liquid covers about one third to one half of the membrane surface. Conveniently, the speed of injection of the beads may be adjusted.

Similarly, various techniques may be employed to remove excess beads from membrane 88. For example, a vacuum may be supplied both at port 84 and at outlet port 104 while a liquid is flowed with a high flow rate, as regulated by valve 54 (see Fig. 2) through inlet 102. Alternatively, a low flow rate may achieved by turning off the vacuum at port 84 while maintaining the vacuum at outlet 104, and adjusting flow regulating valve 54 (see Fig. 2) to produce a low flow rate.

Once the beads have been deposited in the holes of membrane 88, the beads may be transferred from the membrane in an organized manner as described in greater detail hereinafter. Alternatively, gasket 90 may be removed to permit membrane 88 to be removed from device 76 so that assays may be performed on the chemicals synthesized onto the beads. For example, as illustrated in Fig. 5, a pair of membranes 130 and 132 have been removed from device 76. As shown, multiple beads 134 are arrayed on the membranes. Membranes 130 and 132 are placed onto a base agarose layer 136. At least a portion of the chemicals on beads 134 may then be released, such as by using a photolysis process. An agarose layer with bacteria 138 may then be placed on top of beads 134 as shown. The interaction of the released chemicals with the bacteria may then be evaluated as is known in the art. Hence, by utilizing device 76, a convenient way is provided to separate and array large numbers of beads onto a membrane so that the membrane may be removed and used with a lawn assay as is known in the art.

Referring now to Fig. 6, one embodiment of a bead distribution and transfer system 140 will be described. System 140 comprises a base 142 to which are coupled a plurality of legs 144. Also coupled to base 144 is a bead distribution device 146 and a bead transfer device 148. As described in greater detail hereinafter, some of the components of bead distribution device 146 are shared with bead transfer device 148. Further, bead distribution device 146 is constructed to be similar to bead distribution device 76 of Figs. 4 and 5 and will only be briefly described.

Bead distribution device 146 comprises a housing 150 that includes an inlet 152 and an outlet 154. In this way, liquids and beads may be flowed through housing 150 in a manner similar to that previously described with device 76. Conveniently, a window 156 is provided to permit visualization of the liquids and beads flowing through housing 150. Conveniently, housing 150 is coupled to base 142 by a hinge 158. Also pivotally coupled to base 142 by a hinge 160 is a manifold 162. Disposed over manifold 162 is a membrane 164 that includes a plurality of holes 166 (only a few being shown for convenience of illustration). Conveniently, a gasket 168 is employed to couple membrane 164 about manifold 162 and assure good sealing. As best shown in Fig. 8, manifold 162 includes a port 170 which may be coupled to both a vacuum source and a source of positive pressure.

In operation, housing 150 is pivoted on top of gasket 168 as illustrated in Fig. 7. Liquids and/or beads may then be flowed through housing 150 while a vacuum is applied to port 170 to suction beads into holes 166 in a manner similar to that previously described in connection with device 76. Also, pneumatic clamps 172 may be provided to secure housing 150 to manifold 162. Once the beads have been deposited in holes 166, clamps 172 may be released and housing 150 pivoted away from membrane 164.

Referring now to Figs. 7 and 8, bead transfer device 148 will be described. Bead transfer device 148 comprises a manifold 174 that is coupled to base 142. Disposed in manifold 174 is a vacuum port 176. In this way, a vacuum may be produced within manifold 174 by application of a vacuum to vacuum port 176. Manifold 174 includes a ledge 178 upon which a multi-well plate (not shown) may rest. Preferably, the wells in the multi-well plate include valves, such as capillary holes, that permit the flow of fluids through the valves when a vacuum is applied to port 176. In this way, a vacuum may be provided within each of the wells by application of a vacuum to manifold 174. Exemplary multi-well plates having capillary holes or other valves that may be employed are described in co-pending U.S. Application Serial Number 08/887,141, previously incorporated herein by reference.

As best shown in Fig. 8, once the beads have been arrayed on membrane 164, manifold 162 may be pivoted on top of manifold 174. Optionally, a vacuum may be maintained at port 170 to maintain the beads within their respective holes 166. Optionally, pneumatic clamps 180 may be provided to secure manifold 162 to manifold 174.

To transfer the beads from membrane 164 and into the wells, a vacuum is applied to vacuum port 176. Optionally, positive pressure may also be supplied to port 170. In this way, a flow of fluids may be established through the wells to transfer the beads from membrane 164 and into the wells of the multi-well plate.

After transfer of the beads, clamps 180 may be released and manifold 162 removed from manifold 174. The multi-well plate may then be removed to permit access to the solid supports within the wells. Hence, by utilizing bead transfer device 148, a way is provided to rapidly and efficiently transfer a known quantity of beads into wells of a multi-well plate. Since most multi-will plates have a format that is conducive with other equipment employed to perform assays on the chemicals, evaluation of the chemicals is further facilitated.

The invention has now been described in detail for purposes of clarity and understanding. However, it will be appreciated that certain changes and modifications may be practiced within the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A device for distributing solid supports held within a suspension medium, the device comprising:

a) an attraction surface; and

b) a flow system that may be removably positioned over the attraction surface, wherein the flow system is adapted to flow a suspension medium containing solid supports across the attraction surface to permit at least some of solid supports to be distributed on the attraction surface in an organized array, and wherein the flow system may be moved to provide access to the attraction surface after the solid supports have been attracted to the attraction surface.

2. A device as in claim 1, wherein the attraction surface comprises a membrane having an array of holes.

3. A device as in claim 2, further comprising a vacuum source to create a vacuum at the holes in the attraction surface.

4. A device as in claim 3, further comprising a manifold coupled about the membrane and wherein the manifold is in communication with the vacuum source.

5. A device as in claim 1, wherein the flow system comprises a housing defining a chamber and includes an inlet and an outlet to permit the suspension medium to be moved through the chamber.

6. device as in claim 5, further comprising a gasket disposed about the attraction surface.

7. A device as in claim 6, further comprising a clamp to secure the housing to the gasket.

8. A device for transferring solid supports, comprising:

a) an attraction surface having an array of holes that are each adapted to receive a solid support; and

b) a plate having a plurality of wells that each include a hole, wherein the plate is adapted to be operably coupled to a vacuum source to draw the solid supports from the attraction surface and into the wells.

9. A system for distributing and transferring solid supports, the system comprising:

a) a distribution device that is adapted to produce a flowing stream of solid supports held within a suspension medium and to distribute at least some of the solid supports into an organized array; and

b) a transfer device that is adapted to transfer at least some of the distributed solid supports to an acceptor member in an organized manner.

10. A system as in claim 9, further comprising an attraction surface that is shared by both the distribution device and the transfer device.

11. A system as in claim 10, wherein the attraction surface comprises a membrane having an array of holes for receiving the solid supports, and further comprising a vacuum source to provide a vacuum at the attraction surface to attract the solid supports to the holes in the attraction surface.

12. A system as in claim 11, further comprising a pressure source to force the solid supports from the membrane and to the acceptor member.

13. A system for distributing and transferring solid supports, the system comprising:

a) an attraction surface;

b) a flow system that is adapted to flow a suspension medium containing solid supports across the attraction surface to permit at least some of solid supports to be attracted to the attraction surface in an organized array; and

c) a transfer system that is adapted to transfer at least some of the solid supports from the attraction surface in an organized array.

14. A system as in claim 13, further comprising a base member, and wherein the attraction surface, the flow system and the transfer system are operably coupled to the base member.

15. A system as in claim 14, wherein the attraction surface and the flow system are pivotally coupled to the base member to permit the flow system to be pivoted over the attraction surface when flowing the suspension medium across the attraction surface, and to permit the attraction surface to be pivoted over at least a portion of the transfer system when transferring the solid supports in the organized array.

16. A system as in claim 13, wherein the flow system comprises a housing defining a chamber and includes an inlet and an outlet to permit the suspension medium to be moved through the chamber.

17. A system as in claim 16, wherein the attraction surface comprises a membrane having an array of holes that is positioned against a gasket, and further comprising a clamp to secure the housing of the flow system to the gasket.

18. A system as in claim 17, further comprising a manifold coupled to the gasket and a vacuum source coupled to the manifold to attract the solid supports into the holes.

19. A system as in claim 18, wherein the transfer system comprises a pressure source coupled to the manifold to force the solid supports out of the holes.

20. A system as in claim 17, wherein the transfer system further comprises a plate having a plurality of wells that each include a hole, and wherein the wells are aligned with the holes of the membrane when the membrane is placed over the plate.

21. A method for arraying solid supports, comprising:

a) flowing a suspension of solid supports over an attraction surface; and

b) attracting at least some of the solid supports to the attraction surface such that the attracted solid supports are organized in an array on the attraction surface.

22. A method as in claim 21, wherein the attraction surface includes an array of holes, and wherein the attracting step comprises applying a vacuum to the holes while the suspension is flowing over the attraction surface.

23. A method as in claim 21, further comprising performing an assay on compounds disposed on the solid supports after the solid supports are arrayed on the attraction surface.

24. A method as in claim 21, further comprising performing an assay on compounds disposed on the solid supports after the solid supports are arrayed on the attraction surface.

25. A method for distributing and transferring solid supports, the method comprising:

a) flowing a suspension medium containing solid supports over an attraction surface;

b) attracting at least some of the solid supports to the attraction surface in an organized array; and

c) attracting at least some of the solid supports from the attraction surface to an acceptor member in an organized manner.

26. A method as in claim 25, wherein the acceptor member includes an array of wells and further comprising suctioning the solid supports from the attraction surface to the wells.

27. A method as in claim 25, further comprising releasing the solid supports from the attraction surface and repeating the steps a) through c).

28. A method as in claim 25, further comprising creating a vacuum at the attraction surface to attract the solid supports into an array of holes in the attraction surface.

29. A method as in claim 26, further comprising drawing a vacuum through holes in the wells of the acceptor member to attract the solid supports into the wells.

30. A method as in claim 25, further comprising pivotally coupling the attraction surface to a base member and pivoting the attraction surface over the acceptor member.

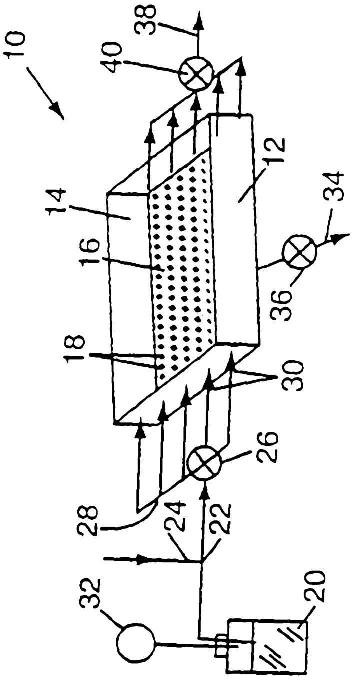
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FIG. 1

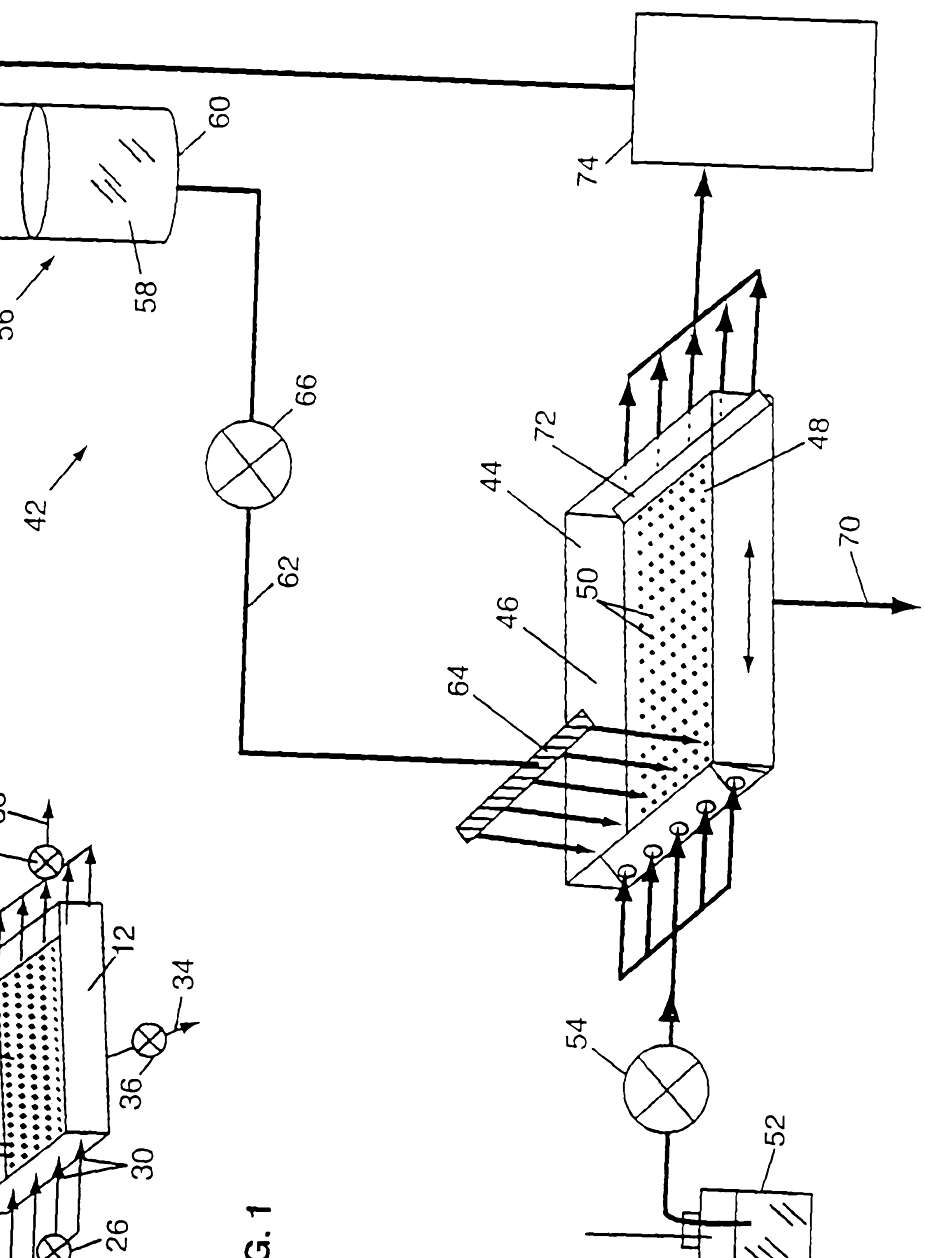
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FIG. 2

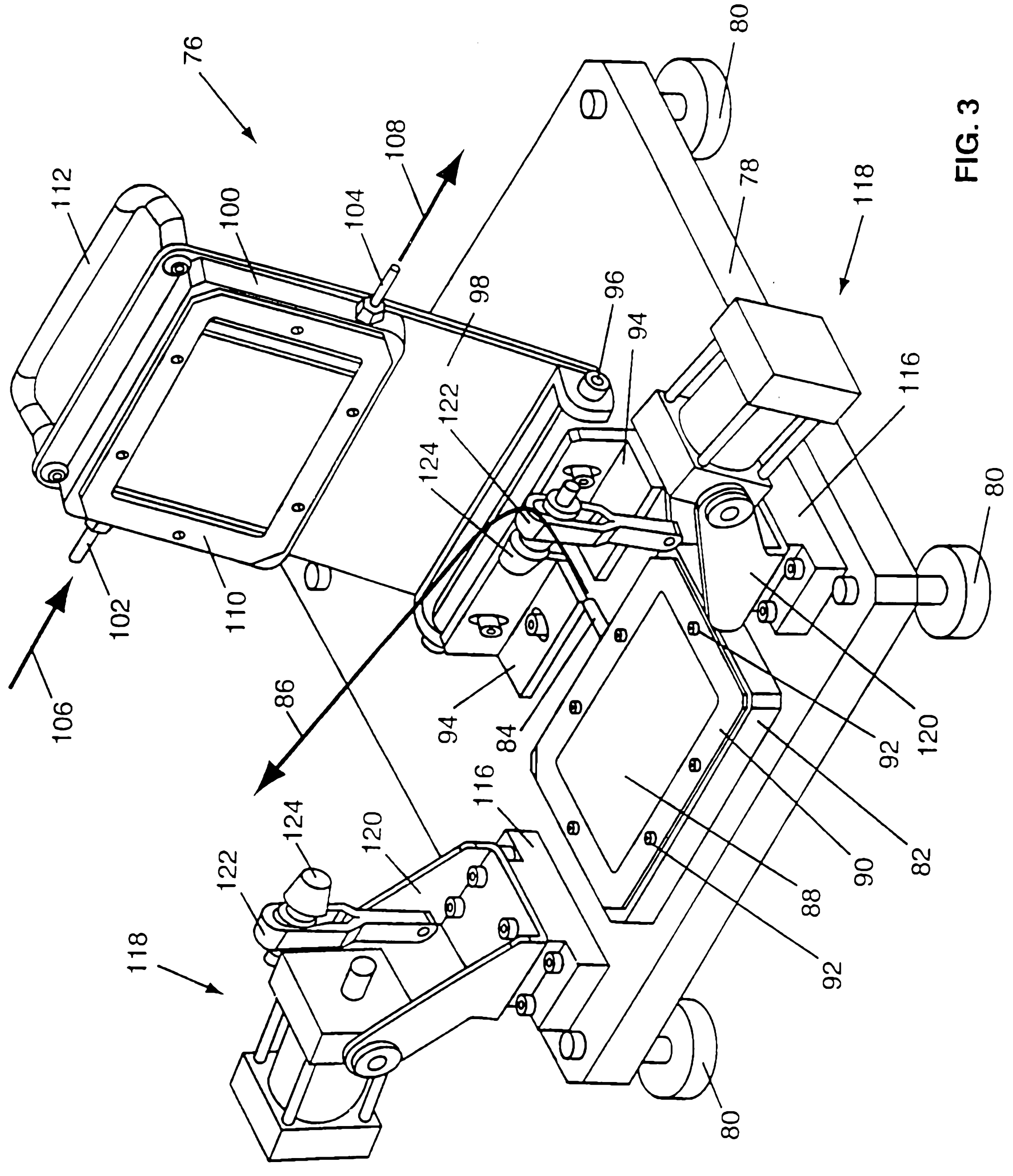
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FIG. 3

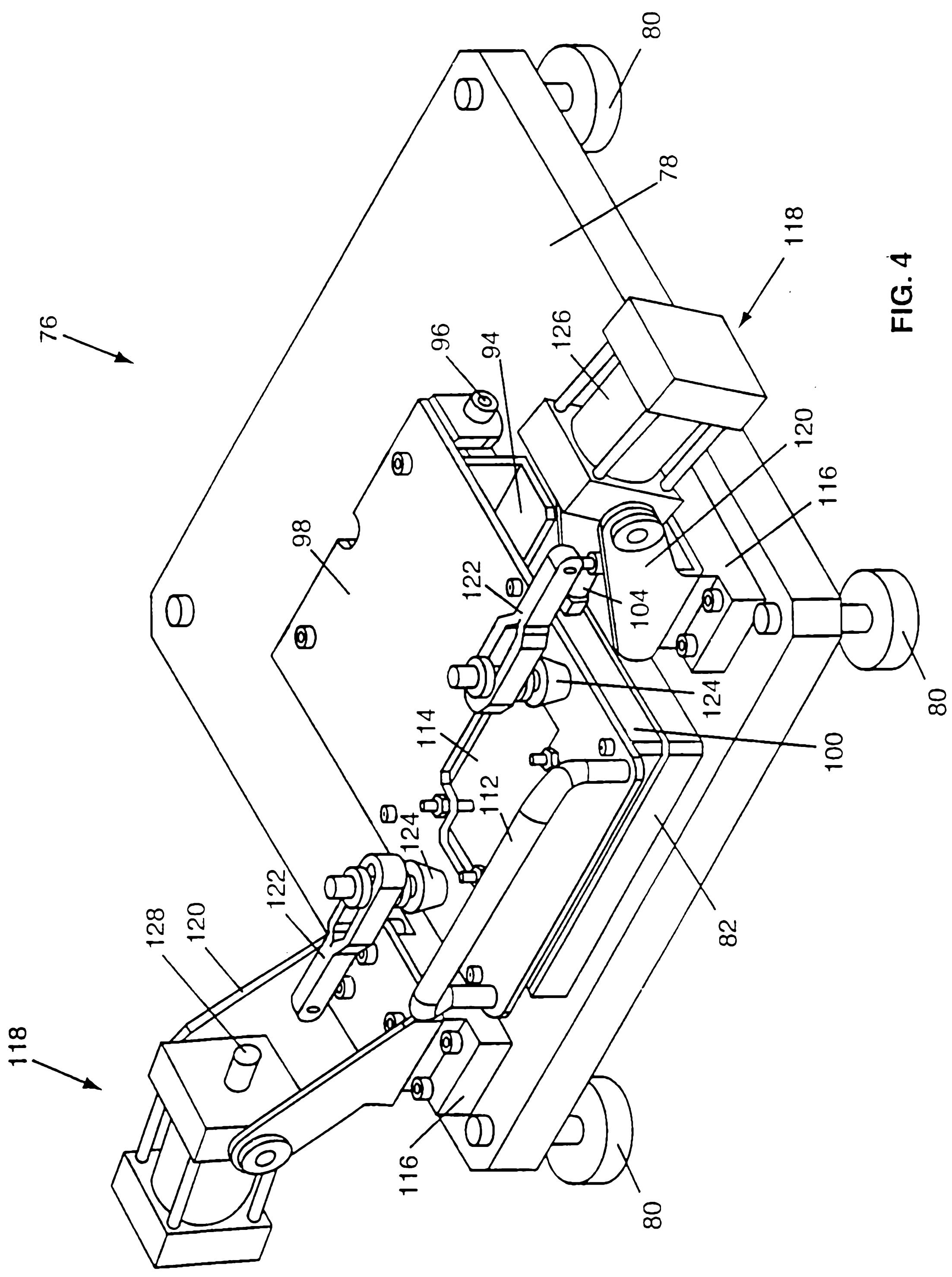

FIG. 4

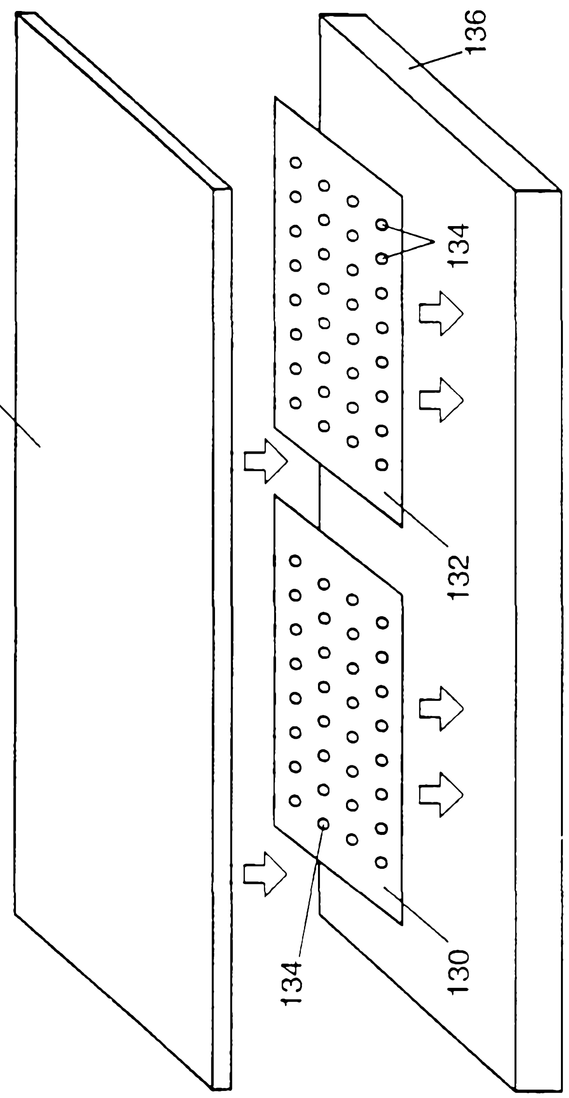

FIG. 5

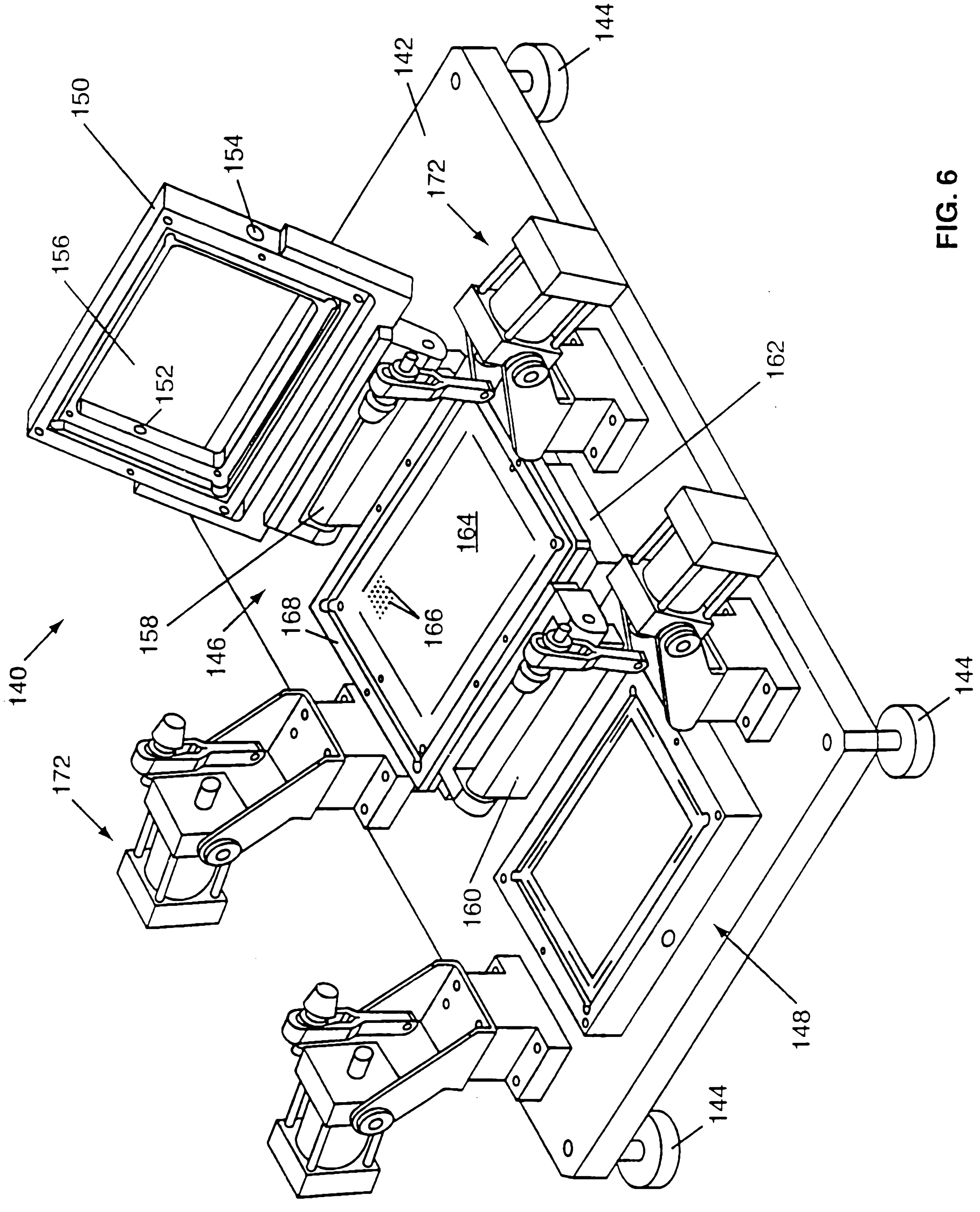
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FIG. 6

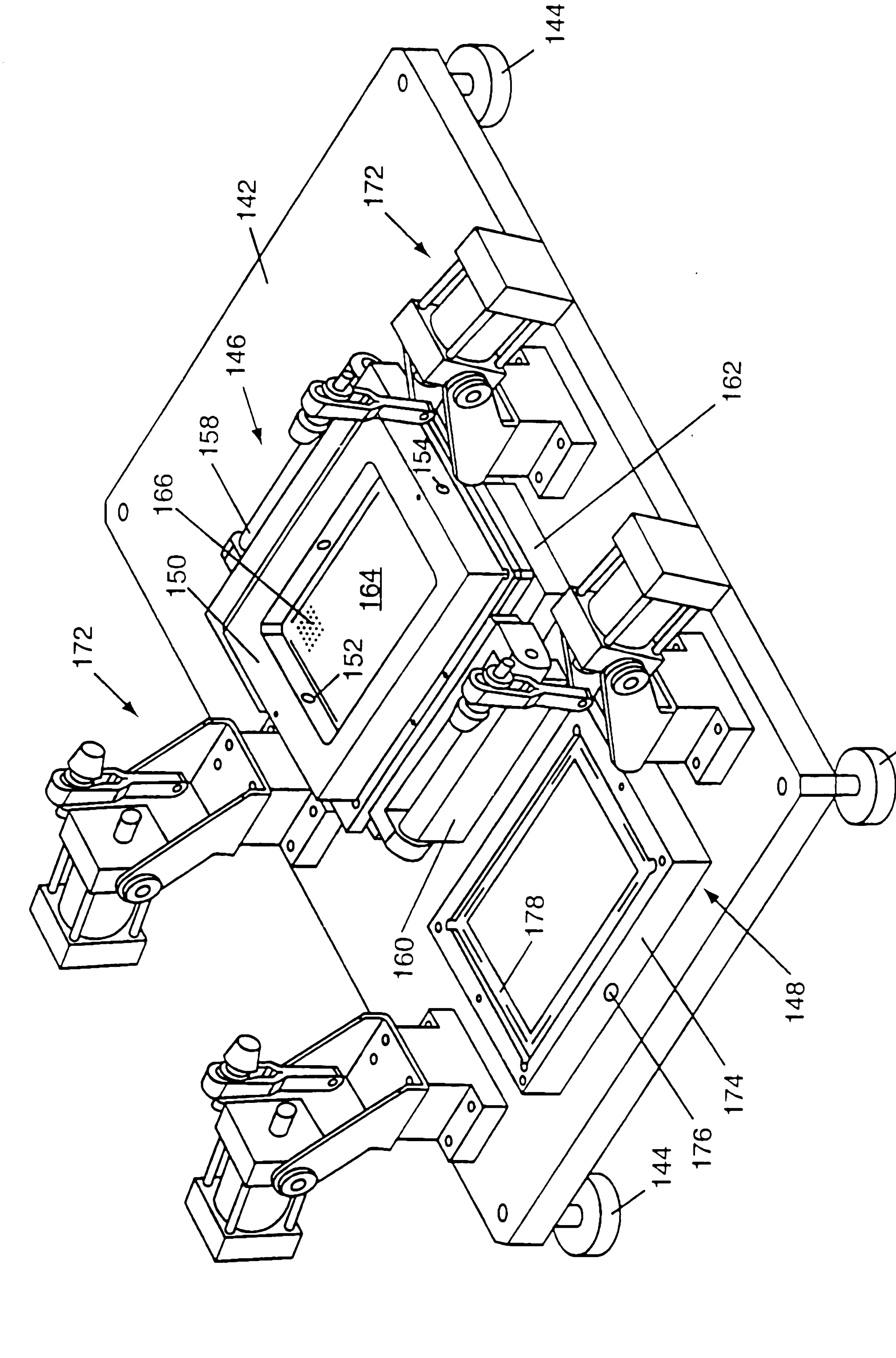
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FIG. 7

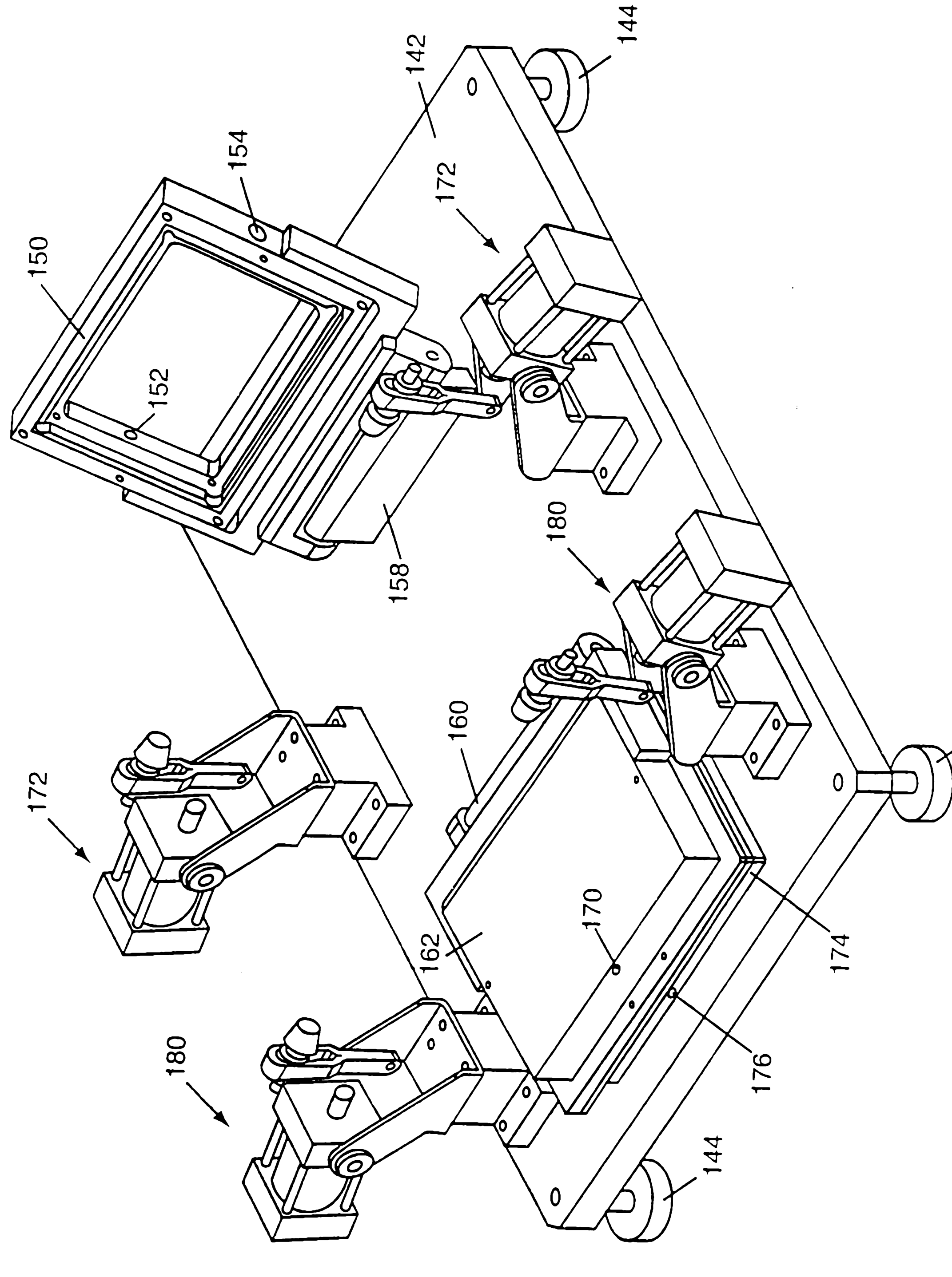
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FIG. 8