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(54) USE OF A PIPETTE TIP ADAPTER

VERWENDUNG EINES PIPETTENSPIITZENADAPTERS

UTILISATION D'UN ADAPTATEUR D'EMBOUT DE PIPETTE

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US-A1- 2004 071 602

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Description

BACKGROUND

1. Field on the Invention

[0001] This disclosure relates generally to multichannel air displacement pipettors employing disposable pipette tips, and is concerned in the particular with the provision of an adapter for providing an interface between the pipette tips and the pipettor.

2. Description of the Related Art

[0002] Air displacement pipettors are typically used to transfer liquids between vessels as part of an assay. Common vessels are microtiter plates, test tubes and reservoirs.

[0003] Air displacement pipettors frequently make use of a piston and cylinder arrangement, which is used to create positive and negative pressure in an attached pipette tip. When the open end of the tip is placed into a liquid, the change in pressure causes the liquid to be aspirated into, or dispensed from, the interior of the pipette tip.

[0004] Cross contamination can occur when a first liquid sample aspirated into and then dispensed from a pipette tip leaves a residual amount of sample in the tip. A subsequently aspirated sample mixes with the residual first sample and is thus contaminated. This type of cross contamination can also occur through residual sample on the exterior of the pipette tip.

[0005] In order to avoid cross contamination errors, most air displacement pipettors are designed to make use of pipette tips that are relatively low cost and therefore, in critical applications, disposable after each aspirate-dispense cycle. The design of the pipette tip and its associated mounting shaft is well established. The pipette tips are commonly injection molded in a chemically resistant material such as polypropylene. They are conical in shape. The pipettor's mounting shaft is typically cylindrical with a slight taper that closely matches the conical angle and diameter of the tip. The tip is installed by applying an axial force to the mounting shaft that forces the tapered portion of the shaft into the tip. Flexibility of the tip material allows it to stretch radially and provide both an air-tight seal and mechanical stability of the tip to the pipetting device. The typical axial force required to securely mount a single tip onto a tip mounting shaft is between 1.5 and 4 lbs (6.7 and 18 N). To remove the pipette tip from the pipettor, a stripper mechanism is typically used to push the tip from the mounting shaft. Tip ejection forces are in the same range as the mounting forces.

[0006] In order to increase productivity, air displacement pipettors with 96, 384 and higher numbers of channels have been developed. These multichannel pipettors must generate relatively high force in the direction of the

axis of the tips in order to simultaneously install the array of tips. For example, a 96 channel pipettor using tips with average insertion forces will require over 200lbs (890 N) of axial force to successfully install all of the tips. These forces are typically generated through the use of mechanical force multipliers (levers) or powered electromechanical systems. The structure of the pipettor has to be robust in order to support the high tip loading force without distortion. This leads to heavier designs that require more power to operate effectively. In addition to these design issues, the safety of the user is also a significant concern when such high forces are present.

[0007] Pipette tips are frequently packaged in a rack that positions them with their top surfaces in a common plane with centerline spacing that matches that of the instrument. For example, a 96 channel pipette tip rack holds an 8 x 12 array of tips with 9mm between centers. The high forces required to attach all of the tips in the rack often causes the tip rack to bow in the center of the array, resulting in poor sealing and attachment of centrally located tips. To counter this, tip manufacturers reinforce the tip racks intended for use with multichannel pipettors. This, in turn, increases the cost of the racks and therefore the cost to operate the instrument.

[0008] Other multichannel pipettor manufacturers have developed proprietary pipette tips that are designed to lower the insertion and ejection forces. These tips are often more complex and expensive to produce and usually lock the customer into purchasing the manufacturer's specially designed tip for the life of the instrument.

[0009] US 2002/086440 A1 discloses a known multichannel pipetting apparatus for simultaneous pipetting of a plurality of sample wells or containers. The pipetting channels of the apparatus have been divided into groups, which are connected via an adapter containing a plurality of channels to pipetting tips of a known type. By changing the adapter or the adapter zone, a suitable configuration for different sample plates or containers is selected.

[0010] US 4237095 A discloses a disposable pipette tip vessel intended for use in connection with a dosage pipette. The upper part of said tip vessel is designed so that it can be connected, by means of a friction joint, to the lower part of the cylindrical portion of the pipette or of an extension of said cylindrical part. The lowest point of the tip vessel is provided with a hole for suction of the liquid to be pipetted into the tip vessel and, correspondingly, for emptying the tip vessel of the liquid contained therein.

SUMMARY

[0011] Broadly stated, embodiments of the present invention address the drawbacks of the prior art by providing a pipette tip adapter whose purpose is to adapt commonly available low cost pipette tips to a multichannel air displacement pipettor in a way that reduces the mounting and ejection forces described above. Any universal pipette tip available in the marketplace can be assembled

to the pipette tip adapter. End users of the related multichannel air displacement pipettor designed to accept the pipette tip adapter would install the assembly onto the pipettor. The pipette tip adapter reduces the forces required to mount and seal the tips to less than 10 lbs (44 N). Ejection forces are equally reduced.

[0012] The method of connecting a multichannel air displacement pipettor to an array of pipette tips, using the adapter as disclosed herein, is defined by the appended claims. Further embodiments are set out in the dependent claims, in the following description and in the drawings.

[0013] In exemplary embodiments, the pipette tip adapter as disclosed herein comprises a planar base with an array of openings extending between its top and bottom surfaces. Sealing tubes project upwardly from top surface of the base, and tip mounting tubes project downwardly from the bottom surface of the base. Pairs of sealing tubes and tip mounting tubes are arranged coaxially and in communication with respective ones of the openings in the base. The tip mounting tubes are externally dimensioned and configured for insertion into the conical upper ends of pipette tips, and the sealing tubes are externally configured and dimensioned for insertion into ports of a multichannel air displacement pipettor.

[0014] The base may preferably be strengthened by networks of reinforcing ribs on its top and/or bottom surfaces.

[0015] These and other objects, features and advantages of the present invention will become more apparent from a reading of the following detailed description in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a top perspective view of a pipette tip adapter in accordance with an exemplary embodiment;

Fig. 2 is a top view of the pipette tip adapter;

Fig. 3 is a bottom perspective view of the pipette tip adapter;

Fig. 4 is a bottom view of the pipette tip adapter;

Fig. 5 is a bottom perspective view showing the pipette tip adapter attached to an array of pipette tips;

Fig. 6 is a partial sectional view through the pipette tip adapter and attached pipette tips;

Fig. 7 is a perspective view of a multichannel air displacement pipettor designed to employ the pipette tip adapter as described herein;

Fig. 8 is a sectional view on an enlarged scale taken

through the operating head of the pipettor shown in Fig. 7, and showing the pistons fully withdrawn;

Fig. 9 is an enlarged view of a portion of the illustration in Fig. 8; and

Fig. 10 is a view similar to Fig. 8, showing the pistons of the pipettor partially advanced.

DETAILED DESCRIPTION

[0017] With reference initially to Figs. 1- 6, a pipettor tip adapter in accordance with an exemplary embodiment as described herein is generally indicated at 10. The pipette tip adapter comprises a planar base 12 with an array of openings 14 extending between bottom and top surface 16, 18 of the base.

[0018] Sealing tubes indicated typically at 20 project upwardly from the top surface 16, and tip mounting tubes indicated typically at 22 project downwardly from the bottom surface 18. Pairs of sealing tubes 20 and mounting tubes 22 are arranged coaxially and in communication with respective ones of the openings 14 in the base 12.

[0019] The sealing tubes 20 and tip mounting tubes 22 may be arranged in an array of rows and columns. The spacing of the rows and columns matches the commonly available tip spacing of both multichannel pipettors and associated racks found in the marketplace. These in turn match the well positions of commonly available micro titer plates. Nine and four and a half millimeters are two common spacing distances. By way of example, a 96 channel pipettor has twelve rows and eight columns of tips on nine millimeter spacing, while a 384 channel pipettor has a twenty four by sixteen matrix on a four and a half millimeter spacing. This channel pipettor can also be used in a one-dimensional array format. For example, a single row of twelve on a nine mm spacing.

[0020] As can be best seen in Fig. 6, the tip mounting tubes 22 comprise truncated conical cones configured and dimensioned for insertion and sealing interengagement with the conical upper ends 24 of pipette tips 26. Fig. 5 shows an array of pipette tips 26 secured to the tip mounting tubes of the adapter.

[0021] Base 12 may be advantageously strengthened by a network of upper reinforcing ribs 28 on its top surface 16, and/or a similar network of lower reinforcing ribs 30 on its bottom surface 18. The sealing tubes 20 may be located where the upper reinforcing ribs 28 converge, whereas the tip mounting tubes 22 may be located in areas of the bottom surface bracketed by the lower reinforcing ribs 30.

[0022] The sealing tubes 20 have cylindrical walls with chamfered upper ends 20a. The tip mounting tubes 22 project downwardly below the lower reinforcing ribs 30, and the sealing tubes 20 project upwardly above the upper reinforcing ribs 28.

[0023] With reference to Fig. 7, a multichannel air displacement pipettor is generally indicated at 32. The head

34 of the pipettor is designed to accept the pipette adapter 10. To this end, the pipette adapter may be provided with laterally extending rails 36 which are designed to slide into receiving slots in the pipettor head. Tabs 35 also may be provided to facilitate handling the adapter.

[0024] As shown in Figs. 8 and 10, the pipettor head has an array of cylinders indicated typically at 38 matching the array of sealing tubes 20 of the tip adapter 10. The cylinders 38 lead to ports lined with O-rings providing compliant internal sealing surfaces. Although O-rings 40 are shown, any equivalent compliant seal material and appropriate geometry could be employed. For example, a sheet of elastomeric material with a matrix of aligned bore holes could be employed.

[0025] The chamfered upper ends 20a of the sealing tubes serve to lower the insertion forces of the sealing tubes into the ports of the pipettor cylinders 38 while also reducing wear and tear of the O-rings 40 or other like compliant sealing surfaces.

[0026] Pistons indicated typically at 42 are arranged for reciprocal movement in the cylinders 38. In Fig. 8, the pistons 42 are withdrawn in the cylinders 38 away from the adapter 10, and in Fig. 10, the pistons are shown advanced in the cylinders.

[0027] The tip adapter 10 is preferably injection molded using standard tooling methods and common processing techniques. Materials can include any rigid injection moldable polymer, with polypropylene being preferred. Additionally, a polymer with an internal lubricant that blooms to the surface of the part is preferable because the presence of the lubricant on the surface will reduce insertion forces and wear and tear on the seals.

[0028] The exemplary embodiment herein described is preferably disposable. A non-disposable version is also possible, its design being essentially identical but produced from a material that is more robust and autoclavable. In such a design, the tips are installed to the adapter by the user with a dedicated fixture.

[0029] To reduce the capital cost required to build injection molds, multiple tip size geometries can be accommodated in a single adapter by arranging the tip mounting tubes in a tiered geometry, where the larger tips fit on one tier and the smaller tips on a second tier.

[0030] Often, disposable pipette tips incorporate filters. The purpose of the filter is to avoid aerosol contamination of the pipette mechanism by the liquid being pipetted. The pipette tip adapter may be configured to accept such filters, thereby eliminating the need to use expensive tips with filters pre-installed in them.

[0031] In light of the above, it will now be appreciated by those skilled in the art that the adapter as described herein offers significant and heretofore unavailable advantages. The chamfered upper ends 20a of the sealing tubes 20 interact with the O-rings or equivalent compliant sealing materials to beneficially reduce the forces required to connect the pipette tips to the pipettor. For example, in the case of a 96 channel pipettor, the adapter's sealing tubes 20 can be successfully inserted into the

cylinder ports of the pipettor with a minimal coupling force on the order of 10lbs (44 N). This can be accomplished safely without exposing an operator to potential injury.

[0032] The adapter base 12, preferably when strengthened by the upper and/or lower reinforcing ribs 28, 30, provides a rigid platform supporting the tip mounting tubes 22 and sealing tubes 20. Thus, the adapter can be pressed onto an array of pipette tubes without undergoing deflection that might otherwise compromise uniform and reliable sealed insertion of the tip mounting tubes 22. This same rigidity, when coupled with the minimal coupling forces referenced above, results in a more uniform and reliable insertion of the sealing tubes into the pipettor cylinder ports.

[0033] Higher forces may be required to install the pipette tips on the adapter, but this can be accomplished in a factory setting prior to supplying the loaded adapter to a user, or by the user with a specially designed press incorporating appropriate safety features.

[0034] The disclosure herein relates to the following aspects:

a) An adapter for connecting a multichannel air displacement pipettor to an array of pipette tips, said pipette tips having through bores with conical upper ends, and said pipettor having a plurality of ports with compliant internal sealing surfaces, said adapter comprising:

a planar base with an array of openings extending between top and bottom surfaces of said base; sealing tubes projecting upwardly from said top surface, and tip mounting tubes projecting downwardly from said bottom surface, pairs of sealing tubes and tip mounting tubes being arranged coaxially and in communication with respective ones of the openings in said base, said tip mounting tubes being externally dimensioned and configured for insertion into the conical upper ends of said pipette tips, and said sealing tubes being externally configured and dimensional for insertion into the ports of said pipettor and into sealing interengagement with said compliant internal sealing surfaces.

b) The adapter of aspect a wherein said base is strengthened by a network of upper reinforcing ribs on said top surface.

c) The adapter of aspect b wherein said sealing tubes project upwardly above said upper reinforcing ribs.

d) The adapter of aspects a or b wherein said base is strengthened by a network of lower reinforcing ribs on said bottom surface.

e) The adapter of aspect d wherein tip mounting tubes project downwardly below said lower reinforcing ribs.

f) The adapter of aspect a wherein said tip mounting tubes comprise hollow truncated conical cones.

g) The adapter of aspect a wherein said sealing tubes comprise cylindrical walls with tapered upper ends.

h) An adapter for connecting a multichannel air displacement pipettor to an array of pipette tips, said pipette tips having through bores with conical upper ends, and said pipettor having a plurality of ports with compliant internal sealing surfaces, said adapter comprising:

a planar base with an array of openings extending between top and bottom surfaces of said base, said base being strengthened by networks of upper and lower reinforcing ribs arranged respectively on said top and bottom surfaces; sealing tubes projecting upwardly from said top surface and above said upper reinforcing ribs, and tip mounting tubes projecting downwardly from said bottom surface and below said lower reinforcing ribs, pairs of sealing tubes and tip mounting tubes being arranged coaxially and in communication with respective ones of the openings in said base, said tip mounting tubes being externally dimensioned and configured for insertion into the conical upper ends of said pipette tips, and said sealing tubes being externally configured and dimensional for insertion into the ports of said pipettor and into sealing interengagement with said compliant internal sealing surfaces.

i) The adapter of aspect h wherein said tip mounting tubes comprise hollow truncated conical cones.

j) The adapter of aspect h wherein said sealing tubes comprise cylindrical walls with tapered upper ends.

k) A pipette tip adapter comprising:

a planar base with an array of openings extending between top and bottom surfaces of said base; sealing tubes projecting upwardly from said top surface, and tip mounting tubes projecting downwardly from said bottom surface, pairs of sealing tubes and tip mounting tubes being arranged coaxially and in communication with respective ones of the openings in said base, said tip mounting tubes being externally dimensioned and configured for insertion into conical upper ends of pipette tips, and said sealing tubes being externally configured and dimensional for insertion into ports of a multichannel air displacement pipettor.

Claims

1. A method of connecting a multichannel air displacement pipettor to an array of pipette tips (26), said pipette tips (26) having through bores with conical

upper ends, (24) wherein said pipettor has a plurality of ports with compliant internal sealing surfaces, (40), said method comprising the steps of:

providing an assembly comprising an adapter (10) and the array of pipette tips (26), wherein:

the adapter (10) includes a planar base (12) with an array of openings (14) extending between top and bottom surfaces (16, 18) of said base (12), sealing tubes (20) that project upwardly from said top surface (16) and tip mounting tubes (22) that project downwardly from said bottom surface (18) such that pairs of sealing tubes (20) and tip mounting tubes (22) are arranged coaxially and are in communication with respective ones of the openings (14) in said base (12); and

said tip mounting tubes (22) are inserted in the conical upper ends (24) of said pipette tips (26);

inserting said sealing tubes (20) into the ports of said pipettor; and
engaging the sealing tubes (20) in sealing interengagement with said compliant internal sealing surfaces (40) within the plurality of ports of the pipettor.

2. The method of claim 1, wherein said base (12) is strengthened by a network of upper reinforcing ribs (28) on said top surface (16).

3. The method of claim 2, wherein said sealing tubes (20) project upwardly above said upper reinforcing ribs (28).

4. The method of claim 1 or claim 2, wherein said base (12) is strengthened by a network of lower reinforcing ribs (30) on said bottom surface (18).

5. The method of claim 4, wherein said tip mounting tubes (22) project downwardly below said lower reinforcing ribs (30).

6. The method of any one of claims 1-5, wherein said tip mounting tubes (22) comprise hollow truncated conical cones.

7. The method of any one of claims 1-6, wherein said sealing tubes (20) comprise cylindrical walls with tapered upper ends (20a).

8. The method of any one of claims 1-7, wherein the adapter is formed by injection moldable polymer.

9. The method of any one of claims 1-8, wherein the

adapter includes laterally extending rails (36) that are adapted to slide into receiving slots in a pipettor head.

10. The method of any one of claims 1-9, wherein the adapter includes tabs (35) to facilitate handling the adapter. 5
11. The method of any one of claims 1-10, wherein the multichannel air displacement pipettor (32) includes an array of pipettor cylinders (38). 10
12. The method of claim 11, wherein the multichannel air displacement pipettor (32) further includes an array of pistons (42) arranged for reciprocal movement in the array of pipettor cylinders (38). 15
13. The method of claim 12, wherein each pipettor cylinder (38) of the multichannel air displacement pipettor (32) further includes compliant sealing material (40). 20
14. The method of claim 13, wherein the compliant seal material is provided as an array of O-rings (40) that interact with an outer surface of each sealing tube (20). 25
15. The method of any one of claims 1-14, wherein the method further includes the step of reciprocally moving pistons (42) in the cylinders (38). 30

Patentansprüche

1. Verfahren zum Anschließen eines Mehrkanal-Luftverdrängungspipettors an eine Anordnung von Pipettenspitzen (26), wobei die Pipettenspitzen (26) Durchgangsbohrungen mit konischen oberen Enden (24) aufweisen, wobei der Pipettor eine Vielzahl von Anschlüssen mit konformen inneren Dichtungsflächen (40) aufweist, und wobei das Verfahren die Schritte umfasst:
Bereitstellen einer Anordnung, die einen Adapter (10) und die Anordnung von Pipettenspitzen (26) umfasst, wobei:

der Adapter (10) eine planare Basis (12) mit einer Anordnung von Öffnungen (14), die sich zwischen oberen und unteren Oberflächen (16, 18) der Basis (12) erstrecken, Dichtungsrohre (20), die von der oberen Oberfläche (16) nach oben ragen und Spitzenmontagerohre (22), die von der unteren Oberfläche (18) nach unten ragen, umfasst, wobei Paare von Dichtungsrohren (20) und Spitzenmontagerohren (22) koaxial und in Verbindung mit jeweiligen Öffnungen (14) in der Basis (12) angeordnet sind, und wobei die Spitzenmontagerohre (22) in die konischen oberen 50

Enden (24) der Pipettenspitzen (26) eingesetzt sind;

Einsetzen der Dichtungsrohre (20) in die Anschlüsse des Pipettors; und

Einrasten der Dichtungsrohre (20), so dass diese in dichtenden Eingriff mit den konformen inneren Dichtungsflächen (40) in der Vielzahl von Anschlüssen des Pipettors kommen.

2. Verfahren nach Anspruch 1, wobei die Basis (12) durch ein Netzwerk von oberen Verstärkungsrippen (28) auf der oberen Oberfläche (16) verstärkt ist.
3. Verfahren Anspruch 2, wobei die Dichtungsrohre (20) nach oben über die oberen Verstärkungsrippen (28) ragen.
4. Verfahren nach Anspruch 1 oder 2, wobei die Basis (12) durch ein Netzwerk von unteren Verstärkungsrippen (30) auf der unteren Oberfläche (18) verstärkt ist.
5. Verfahren nach Anspruch 4, wobei die Spitzenmontagerohre (22) nach unten unter die unteren Verstärkungsrippen (30) ragen.
6. Verfahren nach einem der Ansprüche 1 - 5, wobei die Spitzenmontagerohre (22) hohle kegelstumpffartige Kegel umfassen.
7. Verfahren nach einem der Ansprüche 1 - 6, wobei die Dichtungsrohre (20) zylindrische Wände mit sich verjüngenden oberen Enden (20a) umfassen.
8. Verfahren nach einem der Ansprüche 1 - 7, wobei der Adapter aus spritzgußfähigem Polymer gebildet ist.
9. Verfahren nach einem der Ansprüche 1 - 8, wobei der Adapter seitlich verlaufende Schienen (36) aufweist, die so gestaltet sind, dass sie in Aufnahmeschlitze in einem Pipettorkopf gleiten können.
10. Verfahren nach einem der Ansprüche 1 - 9, wobei der Adapter Laschen (35) zur erleichterten Handhabung des Adapters aufweist.
11. Verfahren nach einem der Ansprüche 1 - 10, wobei der Mehrkanal-Luftverdrängungspipettor (32) eine Anordnung von Pipettorzyllindern (38) aufweist.
12. Verfahren nach Anspruch 11, wobei der Mehrkanal-Luftverdrängungspipettor (32) ferner eine Anordnung von Kolben (42) aufweist, die zur Hin- und Herbewegung in der Anordnung von Pipettorzyllindern (38) angeordnet sind.
13. Verfahren nach Anspruch 12, wobei jeder Pipettor-

zylinder (38) des Mehrkanal-Luftverdrängungspipetors (32) weiter ein konformes Dichtungsmaterial (40) aufweist.

14. Verfahren nach Anspruch 13, wobei das konforme Dichtungsmaterial als eine Anordnung von O-Ringen (40) bereitgestellt ist, die mit einer äußeren Oberfläche jedes Dichtungsrohrs (20) zusammenwirken.

15. Verfahren nach einem der Ansprüche 1 - 14, wobei das Verfahren weiterhin den Schritt umfasst, die Kolben (42) in den Zylindern (38) hin- und herzubewegen.

Revendications

1. Procédé de raccordement d'un dispositif de pipetage à déplacement d'air multicanal à un ensemble d'embouts de pipette (26), lesdits embouts de pipette (26) ayant des trous traversants avec des extrémités supérieures coniques, (24), dans lequel ledit dispositif de pipetage a une pluralité d'orifices avec des surfaces d'étanchéité internes compatibles, (40), ledit procédé comprenant les étapes consistant à :

fournir un assemblage comprenant un adaptateur (10) et l'ensemble d'embouts de pipette (26), dans lequel :

l'adaptateur (10) inclut une base plane (12) avec un ensemble d'ouvertures (14) s'étendant entre les surfaces supérieure et inférieure (16, 18) de ladite base (12), des tubes d'étanchéité (20) qui font saillie vers le haut à partir de ladite surface supérieure (16) et des tubes de montage d'embout (22) qui font saillie vers le bas à partir de ladite surface inférieure (18) de telle sorte que des paires de tubes d'étanchéité (20) et de tubes de montage d'embout (22) sont disposés de manière coaxiale et sont en communication avec des ouvertures respectives des ouvertures (14) dans ladite base (12) ; et lesdits tubes de montage d'embout (22) sont insérés dans les extrémités supérieures coniques (24) desdits embouts de pipette (26) ;

insérer lesdits tubes d'étanchéité (20) dans les orifices dudit dispositif de pipetage ; et mettre en prise les tubes d'étanchéité (20) en mise en prise réciproque d'étanchéité avec lesdites surfaces d'étanchéité internes compatibles (40) au sein de la pluralité d'orifices du dispositif de pipetage.

2. Procédé selon la revendication 1, dans lequel ladite base (12) est renforcée par un réseau de nervures de renfort supérieures (28) sur ladite surface supérieure (16).

3. Procédé selon la revendication 2, dans lequel lesdits tubes d'étanchéité (20) font saillie vers le haut au-dessus desdites nervures de renfort supérieures (28).

4. Procédé selon la revendication 1 ou la revendication 2, dans lequel ladite base (12) est renforcée par un réseau de nervures de renfort inférieures (30) sur ladite surface inférieure (18).

5. Procédé selon la revendication 4, dans lequel lesdits tubes de montage d'embout (22) font saillie vers le bas en dessous desdites nervures de renfort inférieures (30).

6. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel lesdits tubes de montage d'embout (22) comprennent des cônes coniques tronqués creux.

7. Procédé selon l'une quelconque des revendications 1 à 6, dans lequel lesdits tubes d'étanchéité (20) comprennent des parois cylindriques avec des extrémités supérieures effilées (20a).

8. Procédé selon l'une quelconque des revendications 1 à 7, dans lequel l'adaptateur est formé par un polymère moulable par injection.

9. Procédé selon l'une quelconque des revendications 1 à 8, dans lequel l'adaptateur inclut des rails d'extension latérale (36) qui sont adaptés pour coulisser dans des fentes de réception dans une tête de dispositif de pipetage.

10. Procédé selon l'une quelconque des revendications 1 à 9, dans lequel l'adaptateur inclut des pattes (35) pour faciliter la manipulation de l'adaptateur.

11. Procédé selon l'une quelconque des revendications 1 à 10, dans lequel le dispositif de pipetage à déplacement d'air multicanal (32) inclut un ensemble de cylindres de dispositif de pipetage (38).

12. Procédé selon la revendication 11, dans lequel le dispositif de pipetage à déplacement d'air multicanal (32) inclut en outre un ensemble de pistons (42) disposés pour un mouvement réciproque dans l'ensemble de cylindres de dispositif de pipetage (38).

13. Procédé selon la revendication 12, dans lequel chaque cylindre de dispositif de pipetage (38) du dispositif de pipetage à déplacement d'air multicanal (32)

inclut en outre un matériau d'étanchéité compatible (40).

14. Procédé selon la revendication 13, dans lequel le matériau d'étanchéité compatible est fourni en tant qu'ensemble de joints toriques (40) qui interagissent avec une surface externe de chaque tube d'étanchéité (20).
15. Procédé selon l'une quelconque des revendications 1 à 14, le procédé incluant en outre l'étape consistant à déplacer de manière réciproque des pistons (42) dans les cylindres (38).

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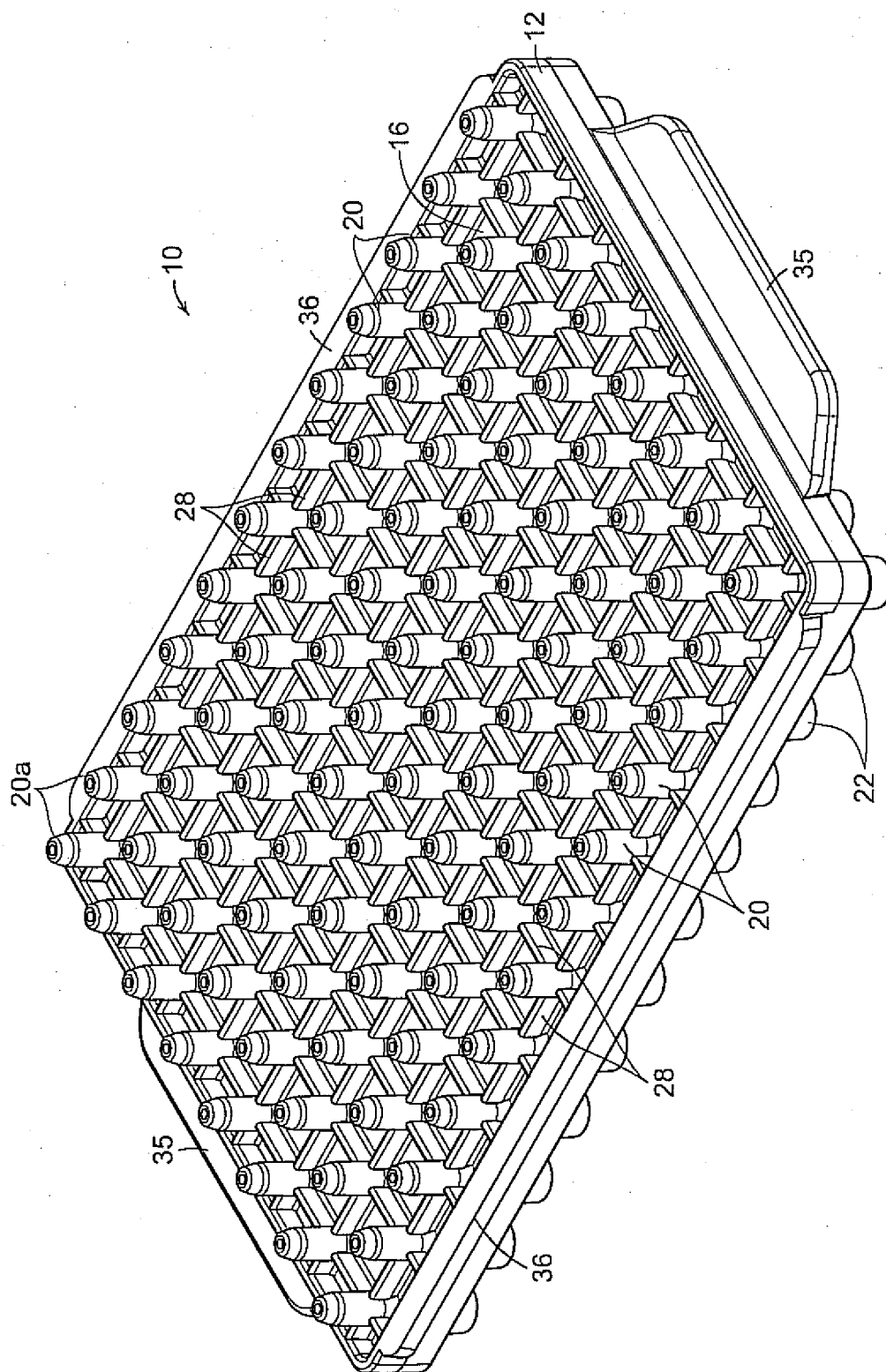


FIG. 1

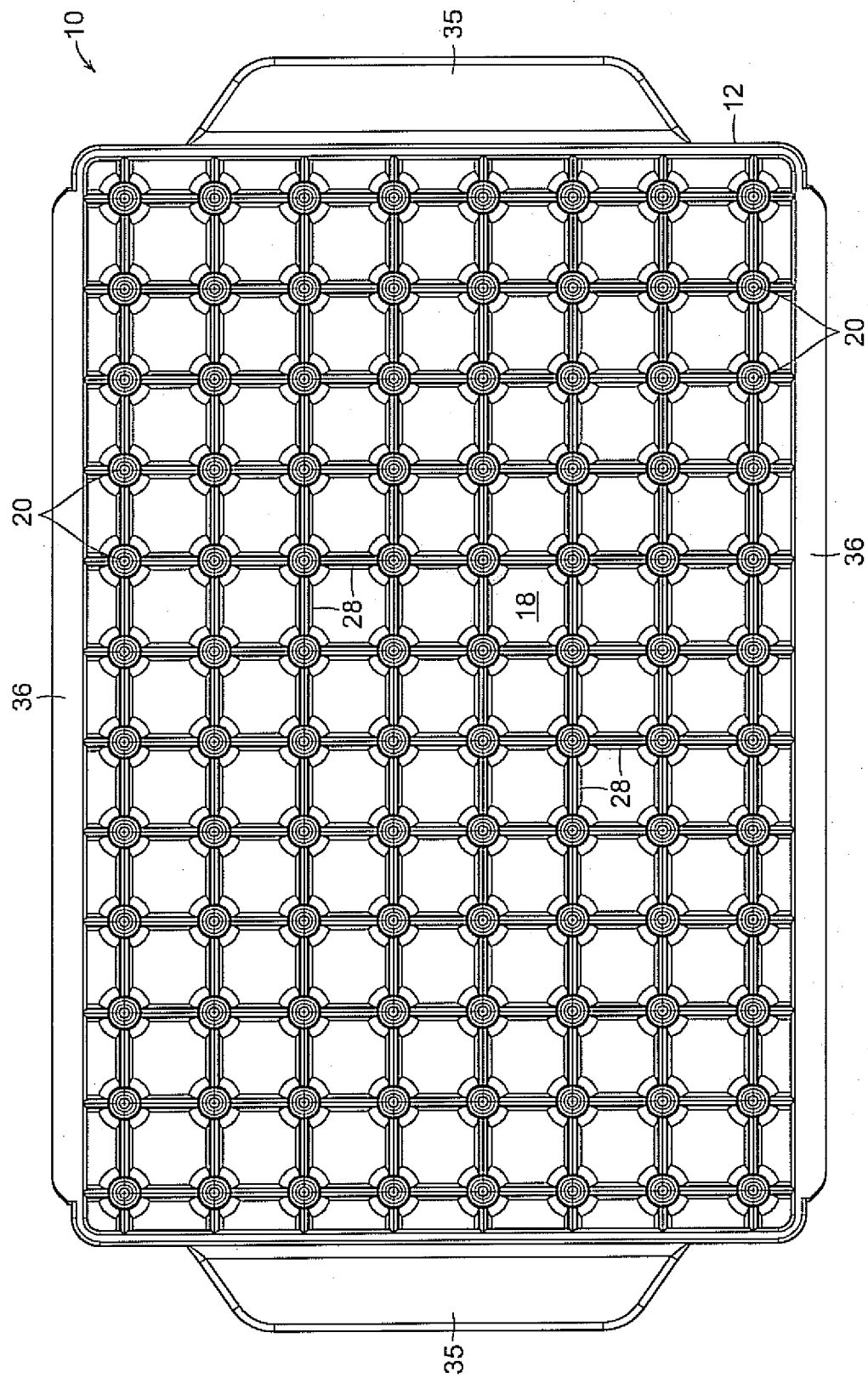


FIG. 2

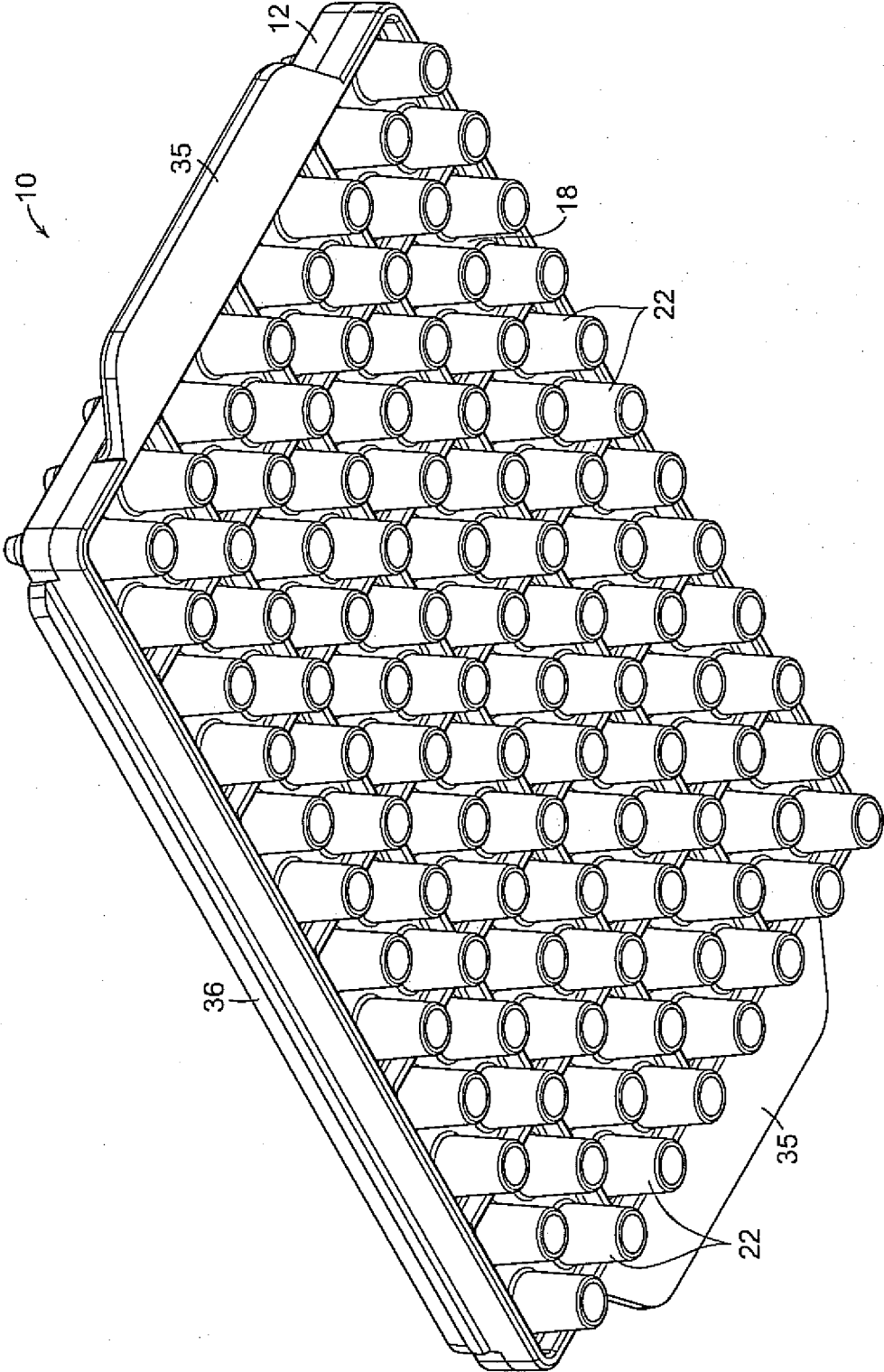


FIG. 3

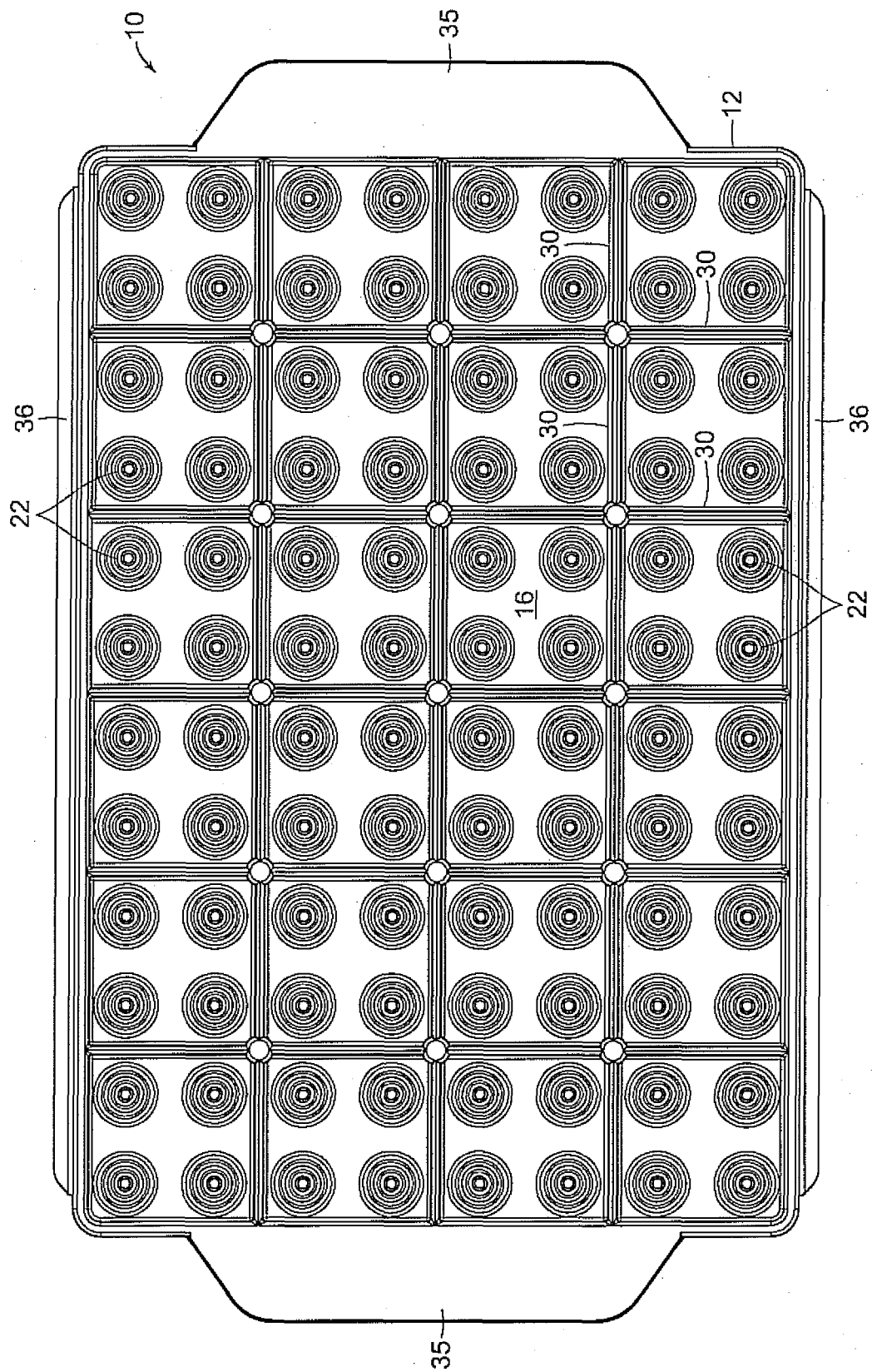


FIG. 4

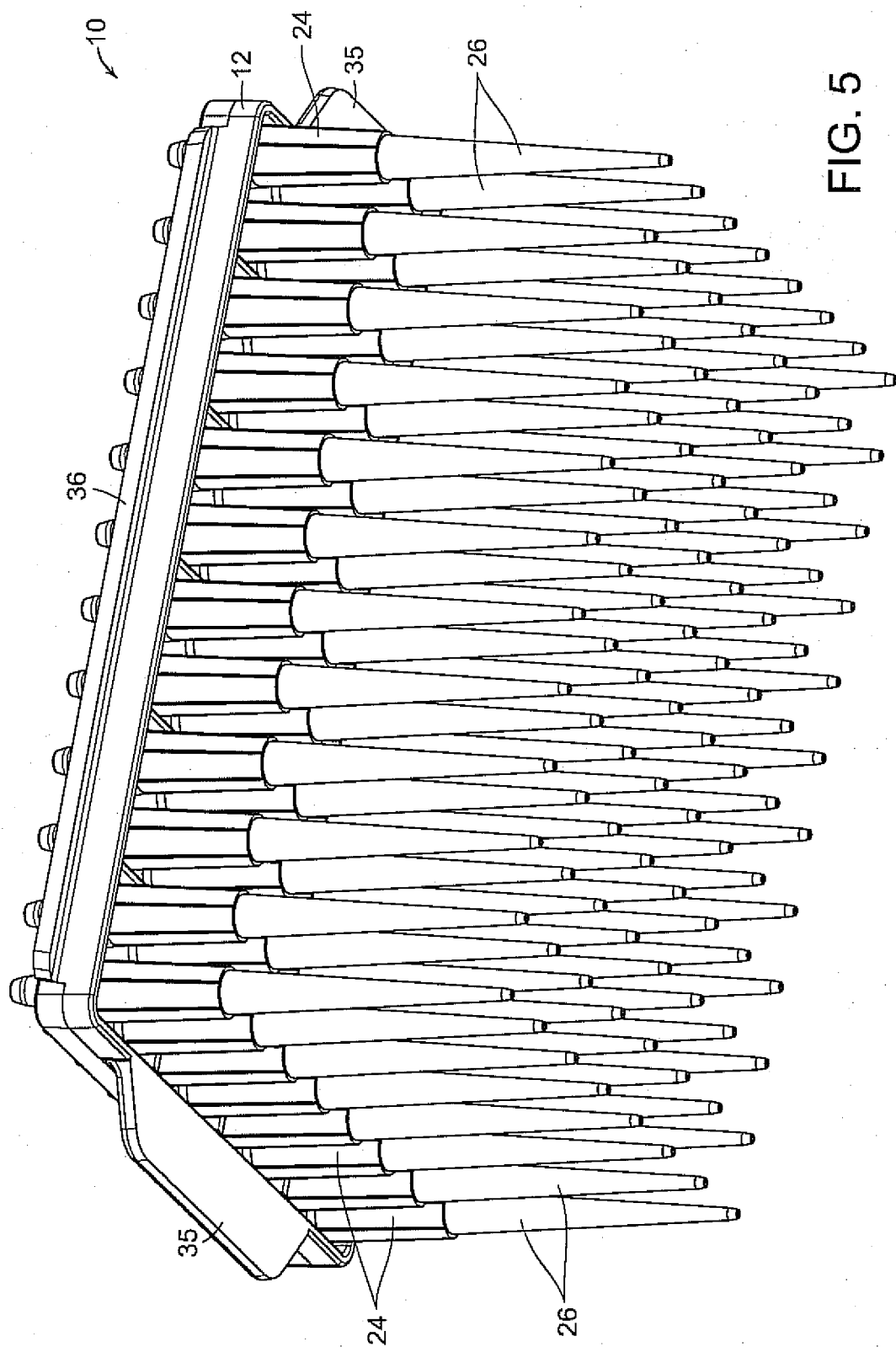


FIG. 5

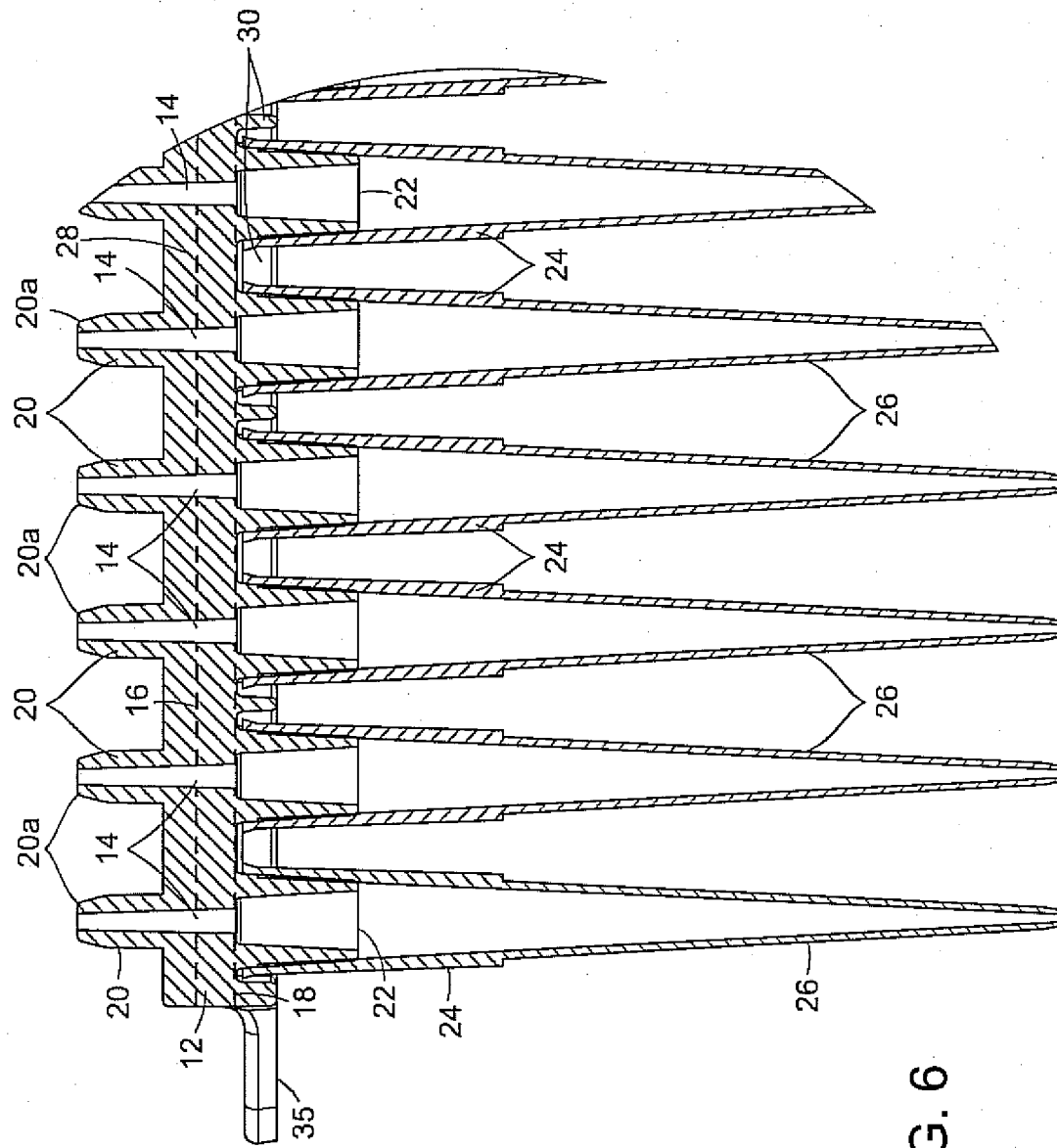


FIG. 6

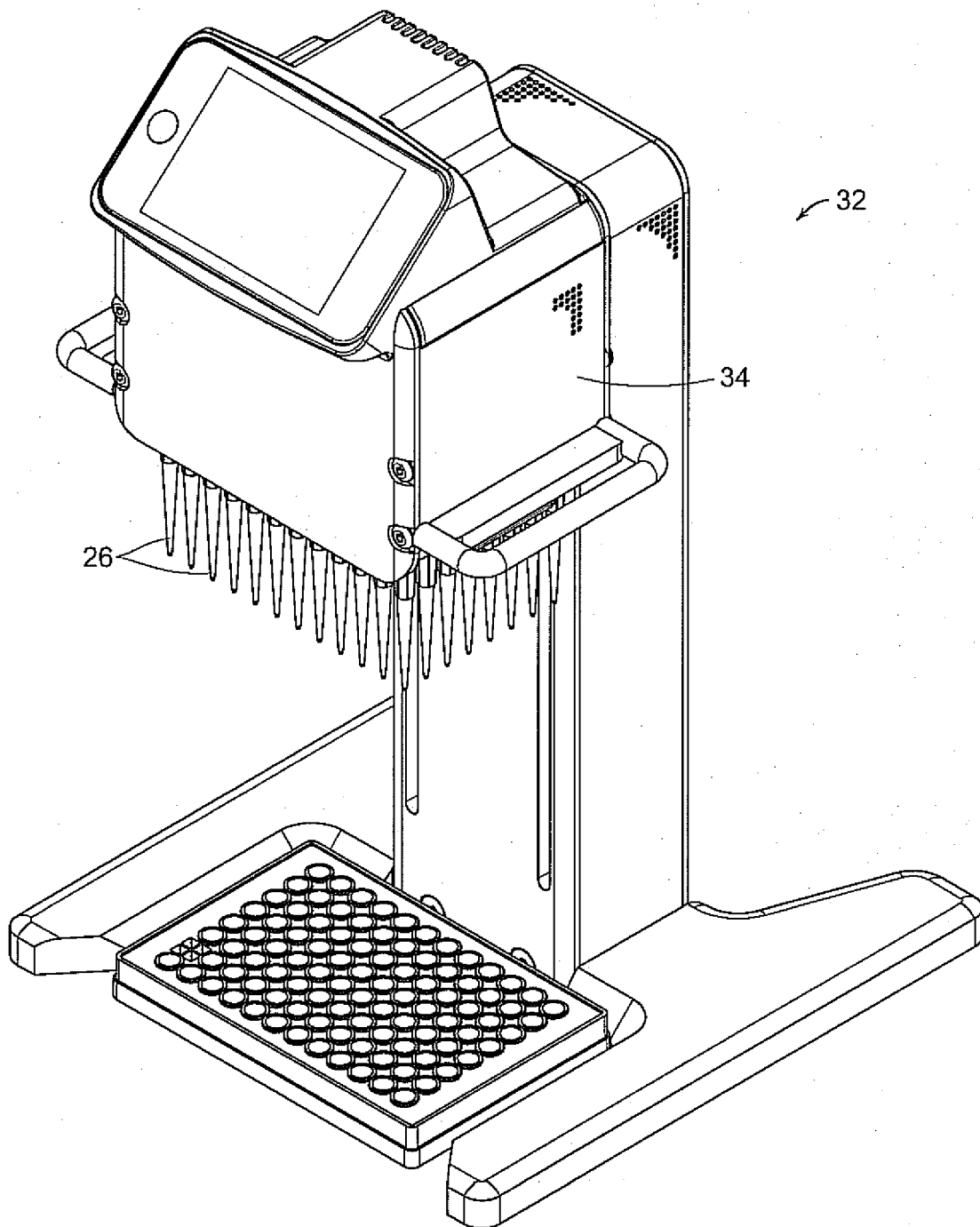


FIG. 7

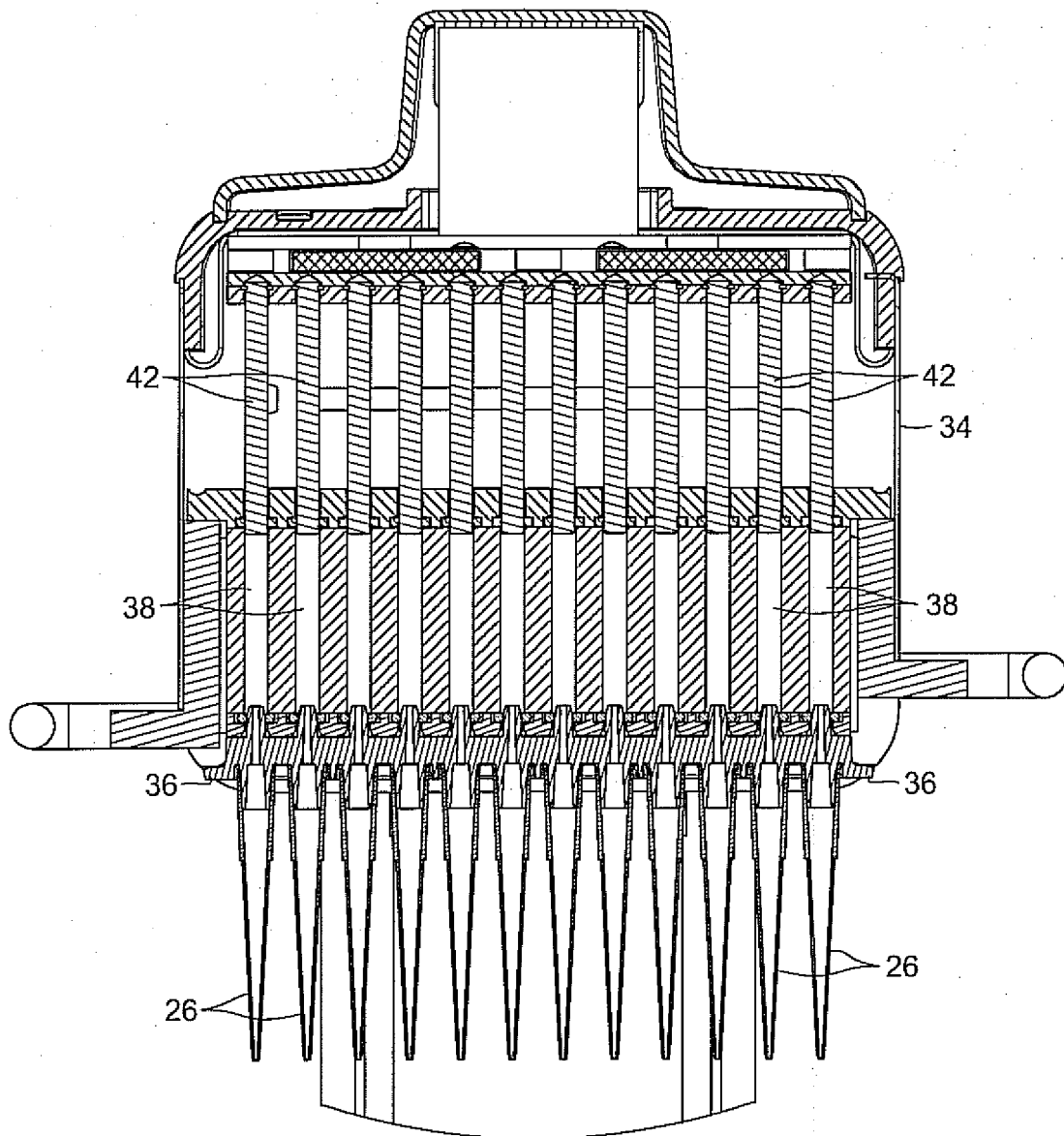
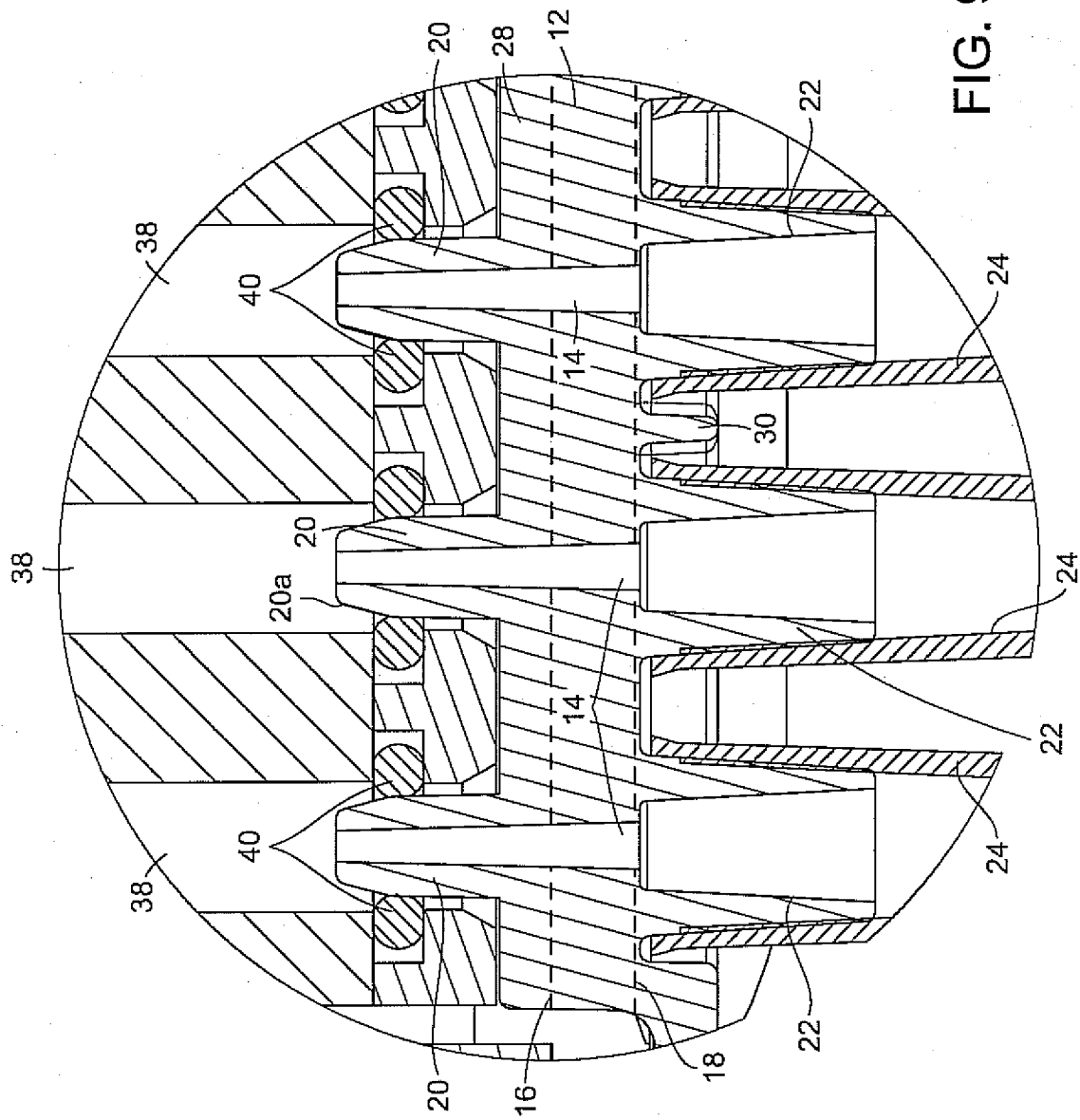


FIG. 8



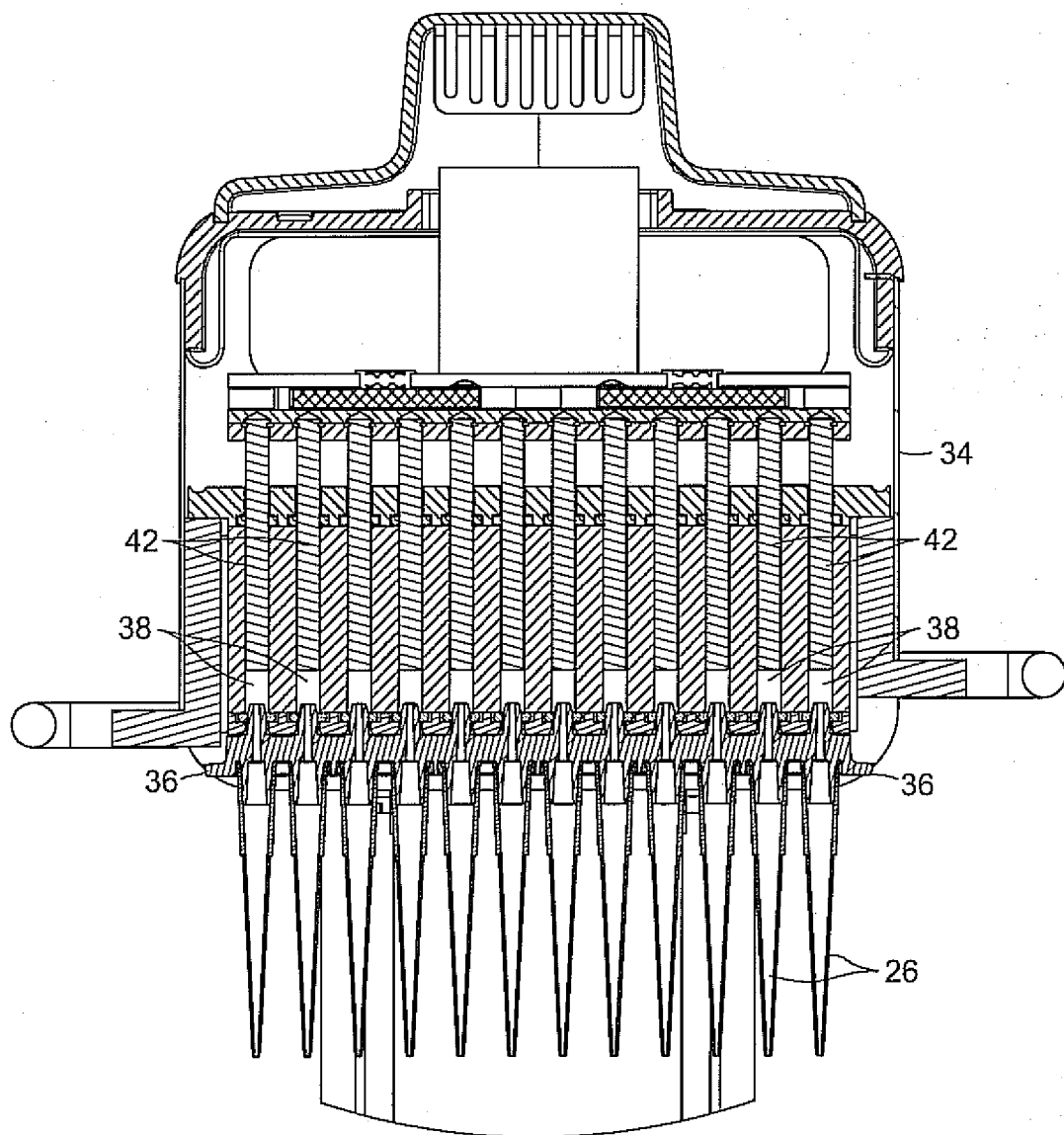


FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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