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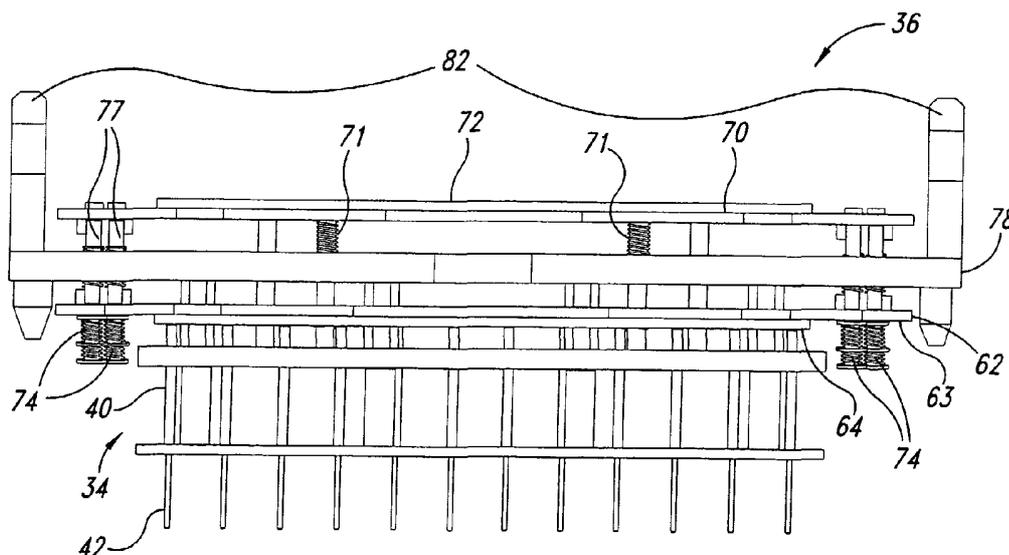
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(54) Title: DISPENSING APPARATUS



(57) Abstract: A pin support assembly (30) includes a pin support frame (32) having a plurality of apertures for supporting an array of pins (34) for dispensing fluids. The pins (34) are supported for longitudinal or "floating" movement to prevent damage to the pins. An actuation assembly (36) engages an end of each of the pins to ensure that the pins are properly seated in the support frame (32) in a planar fashion. The actuation assembly (36) engages the pins as the pins (34) move relatively toward a head block (26) and disengages the pins as the pins move relatively away from the head block (26).

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DISPENSING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention is generally related to apparatus for
5 dispensing controlled amounts of fluid.

Description of the Related Art

Many research and/or manufacturing settings require the delivery
of a precise amount of fluid. Precisely controlling the delivery of fluid can be
important to producing accurate test results or to producing high quality
10 products, as well as being important in lowering costs associated with such
operations. Often, these applications require a large number of repetitive
operations. For example, biological or chemical assays may employ hundreds,
thousands, or more of individual testing steps. Efficiency, accuracy and
repeatability require that these operations be automated. One method of
15 automating is to perform multiple tests at discrete locations on a single plate
(*i.e.*, plate, slide, or array). This requires the delivery of very precise amounts
of fluids, for example agents or reagents, to hundreds or even thousands of
locations on the plate. Other automated methods are of course possible. The
cost of high precision automated equipment is typically substantial.

20 One approach to delivery of a controlled amount of fluid employs
pipette tips. The pipette tip relies on capillary action to draw a precise amount
of fluid from a reservoir into an internal passage of the pipette tip, for delivery to
the desired location. Pipette tips may be particularly suitable for dispensing
fluids in the micro-liter range.

25 U.S. Patent 5,497,670 issued March 12, 1996 discloses a
dispensing apparatus including means for loading pipette tips carried by a
pipette plate onto dispensing cylinders such that a loading force is maintained
during the operation to ensure a hermetic seal. The pipette tips are manually

placed on the pipette tip plate, the pipette tip plate being slidably received within the dispensing apparatus.

U.S. Patent Application Serial No. 08/751,859 filed November 18, 1996 discloses a dispensing apparatus. The dispensing apparatus is similar to that disclosed in the aforementioned patent, but substitutes a more
5 conventional pipette tip carrier for the pipette tip plate, which is less expensive, less likely to be contaminated, and easily adapted for robotic operation or automation.

U.S. Application 10/027,448 filed December 20, 2001 discloses a
10 dispensing apparatus that employs a modified pipette tip box tray carrier to furnish pipette tips carried in a standard pipette tip box to the apparatus, and includes engagement means to engage pipette tip box tray carrier such that the pipette tips are loaded into corresponding internal cylinders formed in a dispense block head of the dispensing apparatus. The dispense block head
15 comprises a solid block of material having a plurality of internal cylinders to engage the pipette tips in a sealing engagement.

A distinctly different approach to precisely dispensing fluids employs one or more pins to retrieve a desired amount of fluid from a reservoir, and to dispense the retrieved fluid to a desired location. In contrast to pipette
20 tips, these pins do not include an internal passage, but rather retrieve a small sample of the fluid as the pin is removed from a reservoir, the fluid forming a droplet on the outer surface at the end of the pin. The amount of fluid retrieved by the pin is a function of a number of parameters including the size, shape and material of the pin and the viscosity of the fluid, all of which affect surface
25 tension. The pin based approach may be particularly suitable for dispensing fluids in the nano-liter range.

Automating the pin based approach would be highly desirable, as would be the taking advantage of the substantial investment made in existing automated equipment such as pipette based dispensing apparatus.

BRIEF SUMMARY OF THE INVENTION

In one aspect, a pin support assembly includes a pin support frame having a plurality of apertures for supporting an array of pins for dispensing fluids. An actuation assembly engages an end of each of the pins to ensure that the pins are properly seated in the support frame in a planar fashion. Interchangeability of the pin support frame with a pipette box tray carrier allows a single drive mechanism to be employed for different operations, for example dispensing very small amounts of fluid versus dispensing very large amounts of fluid, reducing costs.

In another aspect, a pin support assembly for use with a dispense head apparatus having a movable piston plate includes a pin engagement actuation member selectively positionable with respect to the dispense head apparatus to be moved by the piston plate of the dispense head apparatus, a pin engagement member opposed to the pin engagement actuation member and mounted for movement with respect thereto, a biasing member coupled to bias the pin engagement member and the first pin engagement actuation member away from one another, and a linkage coupling the pin engagement actuation member and the pin engagement member to selectively move the pin engagement member and the first pin engagement actuation member towards one another. The pins are supported for longitudinal or "floating" movement to prevent damage to the pins.

In another aspect, a pin support assembly for supporting pins for use with a dispense head apparatus having a movable piston plate and a carrier plate includes a first pin support surface having a first plurality of apertures of a first diameter, a second pin support surface having a second plurality of apertures of a second diameter, the second diameter smaller than the first diameter, the second pin support surface spaced from and coupled to the first pin support surface to form a pin support frame, a pin engagement member opposed to the first pin support surface and mounted for movement with respect thereto between an engaged position where the pin engagement member contacts a respective end of each of a number of pins received in the

first and the second apertures of the first and the second pin support surfaces of the pin support frame, if any, and an unengaged position spaced from the engaged position to disengage the respective ends of the pins received in the first and the second apertures of the first and the second pin support surfaces
5 of the pin support frame, if any; a movable pin engagement actuation member opposed to and spaced across the pin engagement member from the pin support frame, a scissors linkage coupling the pin engagement actuation member and the pin engagement member to selectively move the pin engagement member and the first pin engagement actuation member towards
10 and away from one another, a biasing member coupled to bias the pin engagement member toward the disengaged position, and a set of mounting members sized to receive a set of loading pins on the carrier plate of the dispense head apparatus to selectively position the pin support assembly with respect to the dispense head apparatus such that the pin engagement
15 actuation member is movable by the piston plate of the dispense head apparatus.

In yet another aspect, a dispensing apparatus includes a pin support frame having a plurality of pin receiving apertures, a pin engagement member having a substantially planar pin engagement surface, the pin
20 engagement member selectively movable between an engaged position and a disengaged position spaced from the engaged position, the pin engagement surface being proximate the pin support frame when the pin engagement member is in the engaged position and the pin engagement surface being distal to the pin support frame when pin engagement member is in the disengaged
25 position, a pin engagement actuation member spaced across the pin engagement member from the pin support frame and movable between a first position spaced relatively from the pin support frame and a second position spaced relatively toward the pin support frame, a linkage coupling the pin engagement actuation member and the pin engagement member to selectively
30 move the pin engagement member towards the pin engagement actuation member as the pin engagement member moves toward the disengaged

position and to move the pin engagement member away from the pin engagement actuation member as the pin engagement member moves towards the engaged position, and a drive member couplable to selectively move the pin engagement actuation member between the first position and the second
5 position.

In yet a further aspect, a dispensing apparatus includes a pin support frame having a first plurality of pin receiving apertures of a first diameter and a second plurality of pin receiving apertures of a second diameter smaller than the first diameter, each of the pin receiving apertures of the first
10 plurality aligned with a respective one of the pin receiving apertures of the second plurality for supportingly receiving a respective pin for axial movement with respect thereto, and a pin engagement member having a substantially planar pin engagement surface, the pin engagement member selectively positionable between an engaged position to contact the pins received in the
15 pin receiving apertures if any, and a disengaged position spaced from the engaged position.

In yet a further aspect a dispensing apparatus includes a drive assembly including a drive assembly frame, a drive member mounted to the drive assembly frame for axial movement with respect thereto, and a pin
20 support assembly including a pin support frame having a number of apertures for slidingly receiving a plurality of pins, a pin engagement member mounted for movement with respect to the pin support frame between an engaged position and a disengaged position, and a linkage coupled to move the pin engagement member toward the disengaged position when the drive member moves
25 towards the pin support frame and to move the pin engagement member toward the engaged position when the drive member moves away from the pin support frame, wherein the pin support assembly is selectively attachable and detachable to the drive assembly.

In yet an even further aspect, a dispensing apparatus includes pin
30 support means for supporting each of a plurality of pins, a pin engagement member selectively positionable between an engaged position simultaneously

engaging in a single plane a respective end of each of a plurality of pins and a disengaged position spaced from the engaged position, and actuating means for moving the pin engagement member between the engaged and the disengaged positions.

5 BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

In the drawings, identical reference numbers identify similar elements or acts. The sizes and relative positions of elements in the drawings are not necessarily drawn to scale. For example, the shapes of various elements and angles are not drawn to scale, and some of these elements are
10 arbitrary enlarged and positioned to improve drawing legibility. Further, the particular shapes of the elements, as drawn are not intended to convey any information regarding an actual shape of the particular elements, and are solely selected for ease of recognition in the drawings.

Figure 1 is a front elevational view of a fluid dispensing apparatus
15 with a pipette tip box tray carrier in a disengaged position to load a pipette tip box holding a plurality of pipette tips.

Figure 2 is a partial front elevational view of the fluid dispensing apparatus of Figure 1 with the pipette tip box tray carrier in an engaged position to engage the pipette tips in the pipette tip box with respective ones of internal
20 cylinders formed in a dispense block head of the fluid dispensing apparatus.

Figure 3 is a partially exploded top, front, right isometric view of a pin support assembly having a pin support frame and an actuation assembly for use with the fluid dispensing apparatus of Figures 1 and 2, for example, as a substitute for the pipette tip box and pipette tip box tray carrier thereof.

25 Figure 4 is a further exploded top, front, right isometric view of a pin support assembly of Figure 3.

Figure 5 is a view of an alternative embodiment of the pin support frame of the pin support frame of Figures 3 and 4.

30 Figure 6 is a top, front, right isometric view of the actuation assembly of the pin support assembly of Figure 3.

Figure 7 is a front elevational view of the actuation assembly of Figure 6 in a pin engaged position.

Figure 8 is a front elevational view of the actuation assembly of Figure 6 in a pin disengaged position.

5 Figure 9 is a right side elevational view of the actuation assembly of Figures 7 and 8 showing the pin engaged (broken line) and disengaged positions (solid line).

Figure 10 is an top, front, right isometric view of an alternative block of the fluid dispensing apparatus of Figure 1.

10 Figure 11 is a partial, cross-sectional view along section 11 of Figure 6, illustrating complementary mating portions of the coupling members on the pin support assembly and the carrier plate.

Figure 12 is a partial, cross-sectional view along section line 12 of Figure 6, further illustrating the complementary mating portions of the coupling
15 members on the pin support assembly and the carrier plate.

DETAILED DESCRIPTION OF THE INVENTION

In the following description, certain specific details are set forth in order to provide a thorough understanding of various embodiments of the invention. However, one skilled in the art will understand that the invention may
20 be practiced without these details. In other instances, well-known structures associated with dispensing apparatus, actuators, motors, motor controllers, and automated systems and devices have not been shown or described in detail to avoid unnecessarily obscuring descriptions of the embodiments of the invention.

25 Unless the context requires otherwise, throughout the specification and claims which follow, the word "comprise" and variations thereof, such as "comprises" and "comprising" are to be construed in an open, inclusive sense, that is as "including, but not limited to."

The headings provided herein are for convenience only and do
30 not interpret the scope or meaning of the claimed invention.

Figures 1 and 2 show a fluid dispensing apparatus 10 that includes a piston plate 12, a horseshoe plate 14, and a carrier plate 16. The fluid dispensing apparatus 10 may employ a pipette tip box 18 that holds a number of pipette tips 20 for retrieving and dispensing defined amounts of fluids. The pipette tip box 18 is detachably coupled to the carrier plate 16 by way of a pipette box tray carrier 22. In the illustrated example, the pipette box tray carrier 22 includes a pair of L-shaped ears or lugs for engaging and disengaging a set of loading pins 24 of the moveable carrier plate 16.

In operation, a pipette tip box 18 loaded with a plurality of pipette tips 20 is loaded onto the pipette box tray carrier 22. The pipette box tray carrier 22 is coupled to the carrier plate 16. The pipette box tray carrier 22 moves relative to a dispense block head 26 to selectively engage the ends of the pipette tips 20 with respective ones of a number of internal cylinders formed in the dispense block head 26. The structure and operation of the fluid dispensing apparatus 10 of Figures 1 and 2 is further described in U.S. Patent Application Serial No. 08/751,859, filed November 18, 1996, and in U.S. Patent Application Serial No. 09/442,500, filed December 20, 2001, and thus will not be repeated herein in the interest of brevity and clarity.

Figures 3 and 4 show a pin support assembly 30 for use with dispensing apparatus, such as the dispensing apparatus 10 of Figure 1. The pin support assembly 30 includes a frame 31, a pin support frame 32 for supporting a plurality of pins 34 and an actuation assembly 36 for selectively engaging ends 38 of the pins 34. The frame 31 may support the pin support frame 32 and protect the pins 34 from damage.

Each of the pins 34 has a first portion 40 of a first diameter and a second portion 42 of a second diameter less than the first diameter. The amount of fluid drawn by the pin 34 will in part be a function of the second diameter. In the embodiment illustrated in Figures 3 and 4, the pin support frame 32 includes a first frame member 44 having a plurality of apertures 46 having diameters slightly greater than the first diameter of the first portion 40 of the pin 34. The pin support frame 32 also includes a second frame member 48

having a plurality of apertures 50 having diameters slightly greater than the second diameter of the second portion 42 of the pin 34. The apertures 50 of the second frame member 48 are aligned or in registration with a respective one of the apertures 46 of the first frame member 44. Each of the pins 34 is received in a respective pair of the apertures 46, 50 for axial movement with respect thereto. The second support frame 48 serves as a stop, engaging an edge formed between the first and second portions 40, 42 of the pins 34 to limit the axial travel of the pins 34.

Figure 5 shows an alternative embodiment of the pin support frame 32 employing a single frame member 52 having apertures 46 formed in an upper surface 54 and apertures 50 formed in a lower surface 56. The pins 34 are again supported for axial movement, the difference in the diameters of the first aperture 46 and the second aperture 50 forming a stop to limit the axial travel of the pins 34.

As illustrated in Figures 4, 6, 7, 8 and 9, the actuation assembly 36 includes a pin engagement member 60 mounted for movement with respect to the pin support frame 32 between an engaged position contacting the ends 38 of the pins 34 and a disengaged position spaced from the engaged position. The engaged position is best illustrated in Figure 8, and in broken line in Figure 9. The disengaged position is best illustrated in Figure 7, and in solid line in Figure 9. The pin engagement member 60 may include a plate 62 having an engagement surface 63 and a resilient member or pad 64 attached to the engagement surface 63 of the plate 62.

The actuation assembly 36 includes a linkage 66 coupled to move the pin engagement member 60 toward the disengaged position when a drive member such as the dispense head 26 of the dispensing apparatus 10 moves toward the pin support frame 32, and to move the pin engagement member 60 toward the engaged position when the drive member moves away from the pin support frame 32. The linkage 66 may, for example, take the form of a scissor linkage, as illustrated in Figures 4 and 9. The linkage 66 may include two pairs of linkage members, pivotally coupled by a pivot pin 67, to provide balance and

even force across the pin engagement member 60. The linkage 66 may also include rollers or bushings 69 at the extremities thereof.

The actuation assembly 36 may also include a pin engagement actuation member 68, opposed across the pin engagement member 60 from the pin support frame 36. The pin engagement actuation member 68 may include a plate 70 and resilient member or pad 72, the resilient pad 72 attached to a surface of the plate 70 which is engaged by the drive member, such as the dispense head 26. Thus, the linkage 66 couples the pin engagement actuation member 68 and the pin engagement member 60 to move the pin engagement member 60 toward the disengaged position as the pin engagement actuation member 68 moves toward the pin engagement member and the pin support frame 32, and to move the pin engagement member toward the engaged position as the pin engagement actuation member 68 moves away from the pin engagement member 60 and the pin support frame 32. The actuation assembly 36 may also include biasing members such as leaf springs or coil springs 71 to bias the pin engagement member 60 toward the disengaged position. The actuation assembly 36 may also include additional biasing members such as leaf springs or coil springs 74 biasing the arms of the linkage 66 into engagement with the plates 62, 70 in order to prevent unintended "chatter" or movement of the parts. Proper dimensioning of the various holes 75 and fasteners 77 received through the holes 75, also helps to reduce or eliminate chatter. (Only a small number of the fasteners 77 are illustrated for sake of clarity of the drawings.) As indicated in the Figures, many of the holes 75 may be countersunk, particularly where the holes 75 must accommodate springs 71.

Thus, the pin engagement member 60 engages the ends 38 of the pins 34 in a single plane in response to movement by a drive member such as the dispense head block 26, or a pin head block 76 illustrated in Figure 10. With reference to Figure 10, the pin head block 76 is similar to the dispense head block 26, however, the pin head block eliminates the internal cylinders 13 found in the dispense head block 26.

With continuing reference to Figures 4 and 6-9, the actuation assembly 36 may include an actuation assembly frame member 78 having a pair of slots 79 through which the linkage 66 is received and mounted via the pivot pins 67. The actuation assembly 36 also includes coupling members 80
5 which may have L-shaped ears or lugs 82 or other attachable/detachable coupling structures for selectively coupling the pin support assembly 30 to the carrier plate 16 (Figure 1) of the fluid dispensing apparatus 10.

As best illustrated in Figure 3, 4 and 6, the pin support assembly 30 may include coupling members 80 for selectively engaging and disengaging
10 the loading pins 24 of the movable carrier plate 16 (Figure 1). The coupling members 80 may take the form of two pairs of generally L-shaped ears or lugs. The pin support assembly 30 may include a mating portion having a complementary shape to mate with the loading pins 24. For example the ears or lugs may include a lip formed at a distal end, defining an interior diameter
15 sized and dimensioned to matingly receive a respective one of the loading pins 24.

The pin support assembly 30 may further include a mating portion having a complementary shape to mate with a mating portion of the dispense head apparatus 10. For example, as illustrated in Figures 11 and 12, the
20 coupling members 80 may form all or a part of a mating portion for mating with a portion of the carrier plate 16. For instance, the coupling members 80 may, as illustrated, be tapered or curved in a first direction parallel to a direction of movement of the pin engagement actuation member 68 and may be tapered or curved in a second direction perpendicular to the direction of movement of the
25 pin engagement actuation member 68. This ensures precise positioning of the pins 34 with respect to a target such as locations on a plate, slide or array.

Although specific embodiments of an examples for the dispensing apparatus are described herein for illustrative purposes, various equivalent modifications can be made without departing from the spirit and scope of the
30 invention, as will be recognized by those skilled in the relevant art. The teachings provided herein of the invention can be applied to other dispensing

apparatus, not necessarily the pin dispensing apparatus generally described above.

The various embodiments described above can be combined to provide further embodiments. All of the above U.S. patents, U.S. patent
5 applications and publications referred to in this specification are incorporated herein by reference, in their entirety. Aspects of the invention can be modified, if necessary, to employ systems, circuits and concepts of the various patents, applications and publications to provide yet further embodiments of the invention. These and other changes can be made to the invention in light of the
10 above detailed description. In general, in the following claims, the terms used should not be construed to limit the invention to the specific embodiments disclosed in the specification and the claims, which should be construed to include all dispensing apparatus that operate in accordance with the claims. Accordingly, the invention is not limited by the disclosure, but instead its scope
15 is to be determined entirely by the following claims.

CLAIMS

1. A pin support assembly for use with a dispense head apparatus having a movable piston plate, the pin support assembly comprising:
 - a pin engagement actuation member selectively positionable with respect to the dispense head apparatus to be moved by the piston plate of the dispense head apparatus;
 - a pin engagement member opposed to the pin engagement actuation member and mounted for movement with respect thereto;
 - a biasing member coupled to bias the pin engagement member and the first pin engagement actuation member away from one another;
 - a linkage coupling the pin engagement actuation member and the pin engagement member to selectively move the pin engagement member and the first pin engagement actuation member towards one another.

2. The pin support assembly of claim 1 wherein the pin support assembly is selectively positionable to the dispense head apparatus in place of a box tray carrier of the dispense head apparatus.

3. The pin support assembly of claim 1, further comprising:
 - a set of lugs sized to receive a set of loading pins on the dispense head apparatus to selectively position the pin support assembly with respect to the dispense head apparatus in place of a box tray carrier of the dispense head apparatus.

4. The pin support assembly of claim 1, further comprising:
 - a first pin support surface having a plurality of apertures of a first diameter and a second pin support surface having a plurality of apertures of a second diameter smaller than the first diameter, the second pin support surface spaced from and coupled to the first pin support surface to form a pin support frame.

5. The pin support assembly of claim 1, further comprising:
a mating portion having a complementary shape to mate with a mating portion of the dispense head apparatus.
6. The pin support assembly of claim 1, further comprising:
a mating rail having a complementary shape to mate with a mating portion of the dispense head apparatus, the complementary shape of the mating rail being tapered in a first direction parallel to a direction of movement of the pin engagement actuation member and being tapered in a second direction perpendicular to the direction of movement of the pin engagement actuation member.
7. The pin support assembly of claim 1 wherein the pin engagement member is a substantially flat pin engagement surface.
8. The pin support assembly of claim 1 wherein the pin engagement member is a plate having a substantially flat pin engagement surface, and further comprising:
a resilient pad attached to the pin engagement surface.
9. The pin support assembly of claim 1 wherein the pin engagement actuation member is a plate having a piston plate engagement surface, and further comprising:
a resilient pad attached to the piston plate engagement surface of the pin engagement actuation member.
10. The pin support assembly of claim 1 wherein the pin engagement actuation member is engaged by the piston plate through one of a dispense head block and a pin head block.

11. A pin support assembly for supporting pins for use with a dispense head apparatus having a movable piston plate and a carrier plate, the pin support assembly comprising:

a first pin support surface having a first plurality of apertures of a first diameter;

a second pin support surface having a second plurality of apertures of a second diameter, the second diameter smaller than the first diameter, the second pin support surface spaced from and coupled to the first pin support surface to form a pin support frame;

a pin engagement member opposed to the first pin support surface and mounted for movement with respect thereto between an engaged position where the pin engagement member contacts a respective end of each of a number of pins received in the first and the second apertures of the first and the second pin support surfaces of the pin support frame, if any, and an unengaged position spaced from the engaged position to disengage the respective ends of the pins received in the first and the second apertures of the first and the second pin support surfaces of the pin support frame, if any;

a movable pin engagement actuation member opposed to and spaced across the pin engagement member from the pin support frame;

a scissors linkage coupling the pin engagement actuation member and the pin engagement member to selectively move the pin engagement member and the first pin engagement actuation member towards and away from one another;

a biasing member coupled to bias the pin engagement member toward the disengaged position; and

a set of mounting members sized to receive a set of loading pins on the carrier plate of the dispense head apparatus to selectively position the pin support assembly with respect to the dispense head apparatus such that the pin engagement actuation member is movable by the piston plate of the dispense head apparatus.

12. The pin support assembly of claim 11, further comprising:
a mating portion having a complementary shape to mate with a mating portion of the dispense head apparatus, the complementary shape of the mating portion being tapered in a first direction parallel to a direction of movement of the pin engagement actuation member and being tapered in a second direction perpendicular to the direction of movement of the pin engagement actuation member.

13. The pin support assembly of claim 11 wherein the pin engagement member comprises:
a pin engagement plate having a substantially planar pin engagement surface; and
a resilient pad coupled to the pin engagement surface of the pin engagement plate.

14. A dispensing apparatus, comprising:
a pin support frame having a plurality of pin receiving apertures;
a pin engagement member having a substantially planar pin engagement surface, the pin engagement member selectively movable between an engaged position and a disengaged position spaced from the engaged position, the pin engagement surface being proximate the pin support frame when the pin engagement member is in the engaged position and the pin engagement surface being distal to the pin support frame when pin engagement member is in the disengaged position;
a pin engagement actuation member spaced across the pin engagement member from the pin support frame and movable between a first position spaced relatively from the pin support frame and a second position spaced relatively toward the pin support frame;
a linkage coupling the pin engagement actuation member and the pin engagement member to selectively move the pin engagement member towards the pin engagement actuation member as the pin engagement member

moves toward the disengaged position and to move the pin engagement member away from the pin engagement actuation member as the pin engagement member moves towards the engaged position; and

a drive member couplable to selectively move the pin engagement actuation member between the first position and the second position.

15. The dispensing apparatus of claim 14 wherein the pin receiving apertures of the pin support frame have a first diameter and a second diameter for slidably supporting pins for movement with respect thereto.

16. The dispensing apparatus of claim 14, further comprising:
a spring biasing member biasing the pin engagement member toward the disengaged position.

17. The dispensing apparatus of claim 14 wherein the pin engagement member is a plate and a resilient pad.

18. The dispensing apparatus of claim 14 wherein the pin support frame is detachable from the drive member.

19. The dispensing apparatus of claim 14 wherein the pin support frame, pin engagement member, pin engagement actuation member and linkage are detachable as a unit from the drive member.

20. The dispensing apparatus of claim 14, further comprising:
a number of pins received in the pin receiving apertures.

21. A dispensing apparatus, comprising:
a pin support frame having a first plurality of pin receiving apertures of a first diameter and a second plurality of pin receiving apertures of

a second diameter smaller than the first diameter, each of the pin receiving apertures of the first plurality aligned with a respective one of the pin receiving apertures of the second plurality for supportingly receiving a respective pin for axial movement with respect thereto;

a pin engagement member having a substantially planar pin engagement surface, the pin engagement member selectively positionable between an engaged position to contact the pins received in the pin receiving apertures if any, and a disengaged position spaced from the engaged position.

22. The dispensing apparatus of claim 21, further comprising:

a pin engagement actuation member opposed across the pin engagement member from the pin support frame and selectively positionable between a first position and a second position; and

a linkage coupling the pin engagement actuation member and the pin engagement member to move the pin engagement member towards the disengaged position as the pin engagement actuation member moves towards the pin engagement member and the pin support frame, and to move the pin engagement member away towards the disengaged position as the pin engagement member moves away from the pin engagement member and the pin support frame.

23. The dispensing apparatus of claim 21, further comprising:

a pin engagement actuation member opposed across the pin engagement member from the pin support frame and selectively positionable between a first position and a second position;

a linkage coupling the pin engagement actuation member and the pin engagement member to move the pin engagement member towards the disengaged position as the pin engagement actuation member moves towards the pin engagement member and the pin support frame, and to move the pin engagement member towards the engaged position as the pin engagement

actuation member moves away from the pin engagement member and the pin support frame; and

a drive member selectively couplable and operable to move the pin engagement actuation member.

24. The dispensing apparatus of claim 21, further comprising:
a spring biasing member biasing the pin engagement member toward the disengaged position.

25. The dispensing apparatus of claim 21, further comprising:
a plurality of pins received in the pin receiving apertures.

26. A dispensing apparatus, comprising:
a drive assembly, comprising:
a drive assembly frame; and
a drive member mounted to the drive assembly frame for axial movement with respect thereto; and
a pin support assembly, comprising:
a pin support frame having a number of apertures for slidingly receiving a plurality of pins;
a pin engagement member mounted for movement with respect to the pin support frame between an engaged position and a disengaged position; and
a linkage coupled to move the pin engagement member toward the disengaged position when the drive member moves towards the pin support frame and to move the pin engagement member toward the engaged position when the drive member moves away from the pin support frame,
wherein the pin support assembly is selectively attachable and detachable to the drive assembly.

27. The dispensing apparatus of claim 26 wherein the pin support assembly further comprises a pin engagement actuator member coupled to the pin engagement member by the linkage and drivable by the drive member.

28. The dispensing apparatus of claim 26 wherein drive assembly further comprises a head block movably engagable by the drive member, and wherein the pin support assembly further comprises a pin engagement actuator coupled to the pin engagement member by the linkage and drivable by the drive member through the head block.

29. The dispensing apparatus of claim 26, wherein the drive assembly further comprises a carrier plate having a set of pins, and wherein the pin support assembly further comprises a set of ears sized and positioned for selectively receiving the pins of the carrier plate to selectively attach and detach the pin support assembly from the drive assembly.

30. A dispensing apparatus, comprising:
pin support means for supporting each of a plurality of pins;
a pin engagement member selectively positionable between an engaged position simultaneously engaging in a single plane a respective end of each of a plurality of pins and a disengaged position spaced from the engaged position; and

actuating means for moving the pin engagement member between the engaged and the disengaged positions.

31. The dispensing apparatus of claim 30 wherein the actuating means comprises:

an pin engagement actuator member; and
linkage means for causing the pin engagement member to move toward the disengaged position by moving the pin engagement member toward

the pin engagement actuator member as the pin engagement actuator member moves toward the pin engagement member and for causing the pin engagement member to move toward the engaged position by moving the pin engagement member away from the pin engagement actuator member as the pin engagement actuator member moves away from the pin engagement member.

32. The dispensing apparatus of claim 30, further comprising:
a block head couplable to the actuating means; and
piston drive means for driving the actuating means by way of the block head.

33. The dispensing apparatus of claim 30, further comprising:
drive means for providing axial movement; and
mounting means for selecting mounting the pin support means,
the pin engagement member and the actuating means to the drive means.

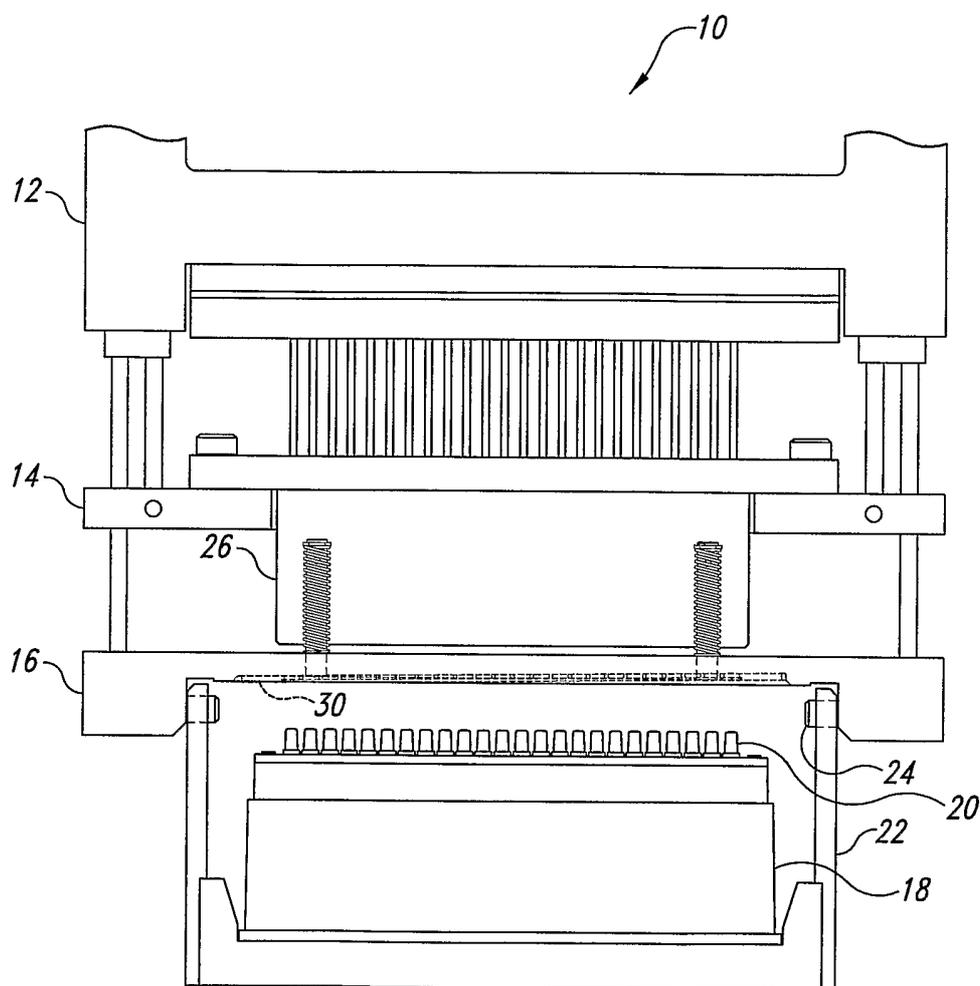


Fig. 1

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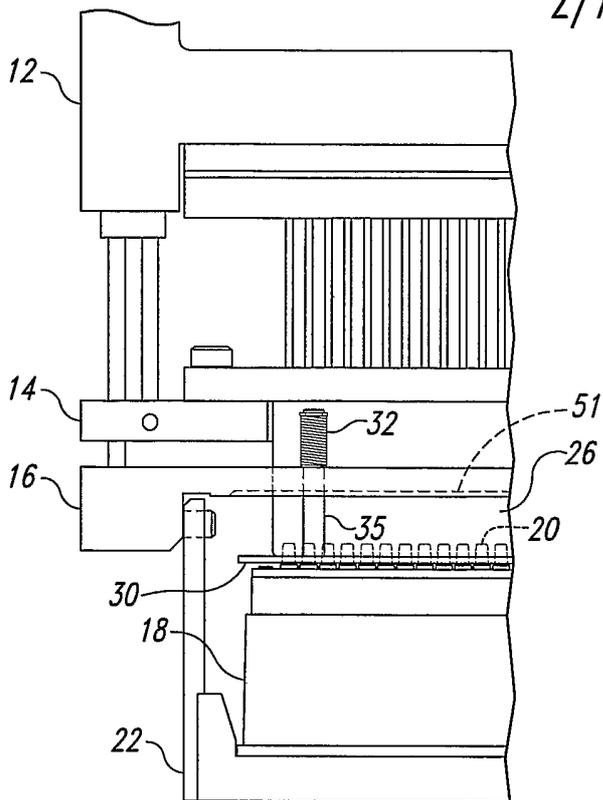


Fig. 2

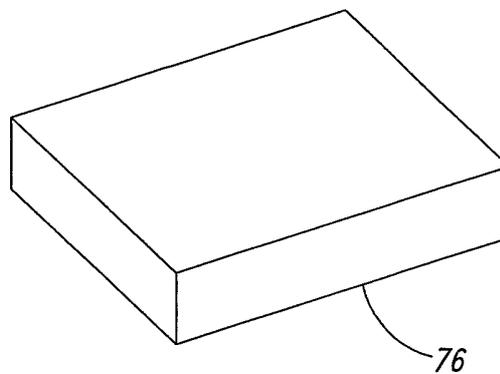


Fig. 10

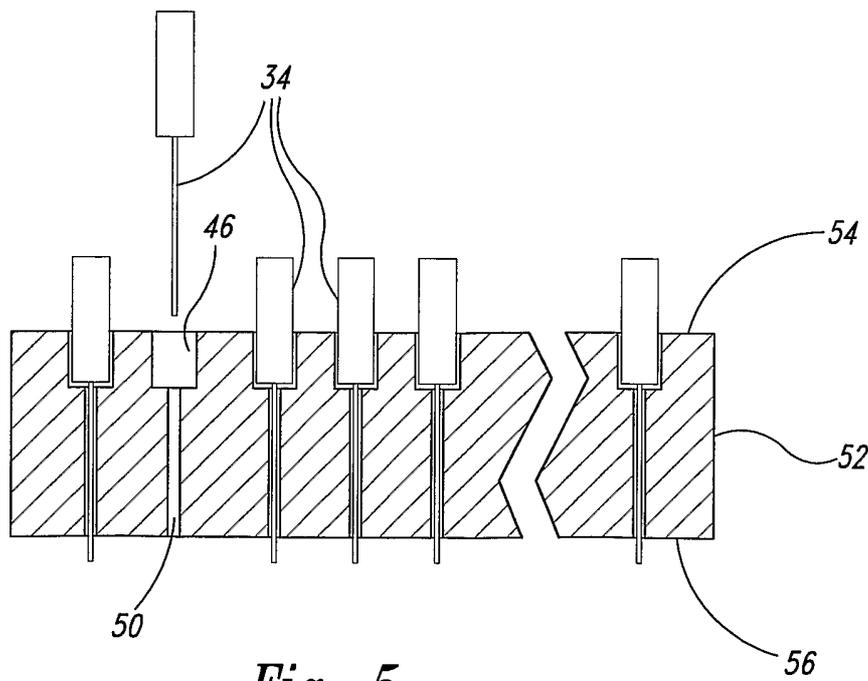


Fig. 5

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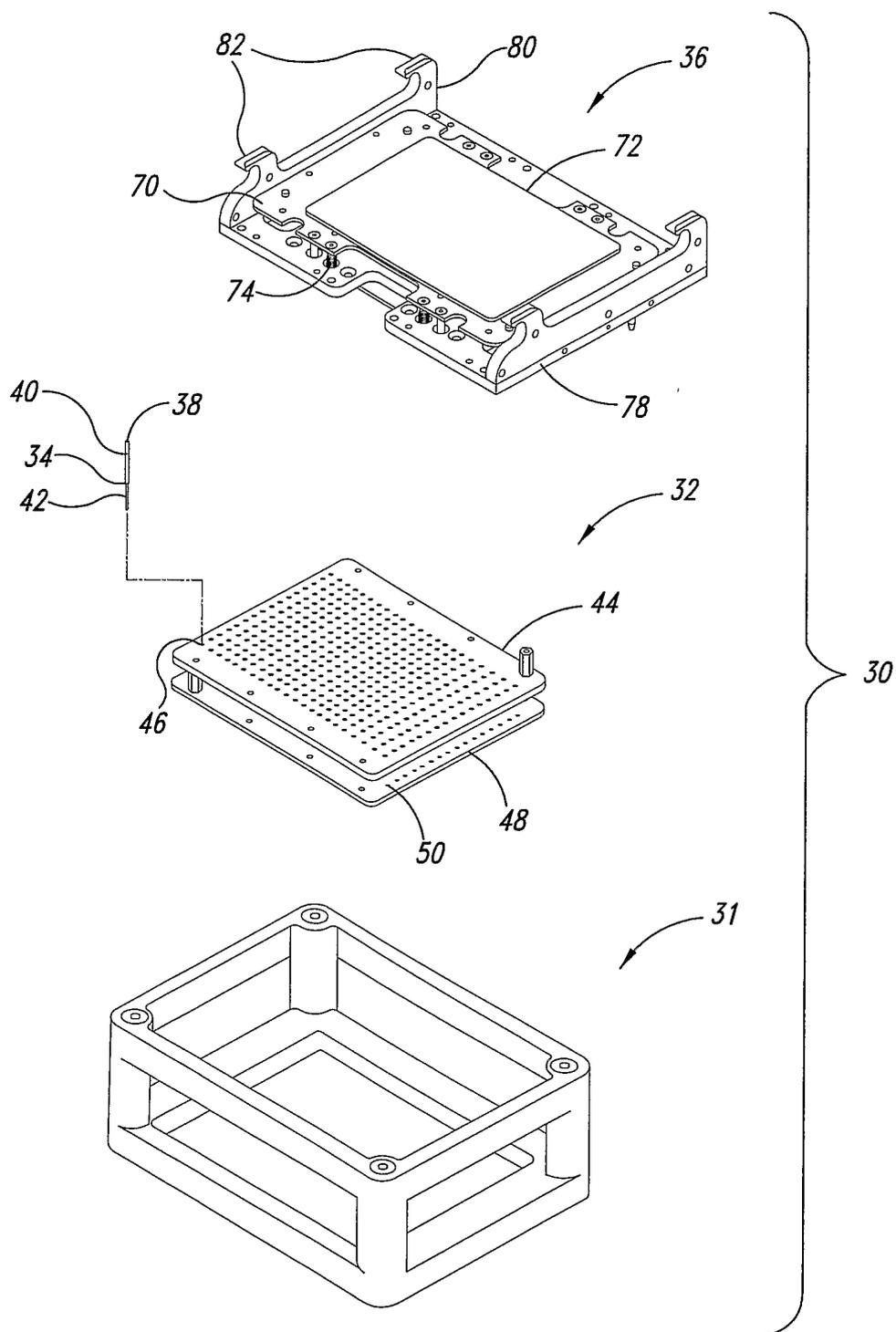


Fig. 3

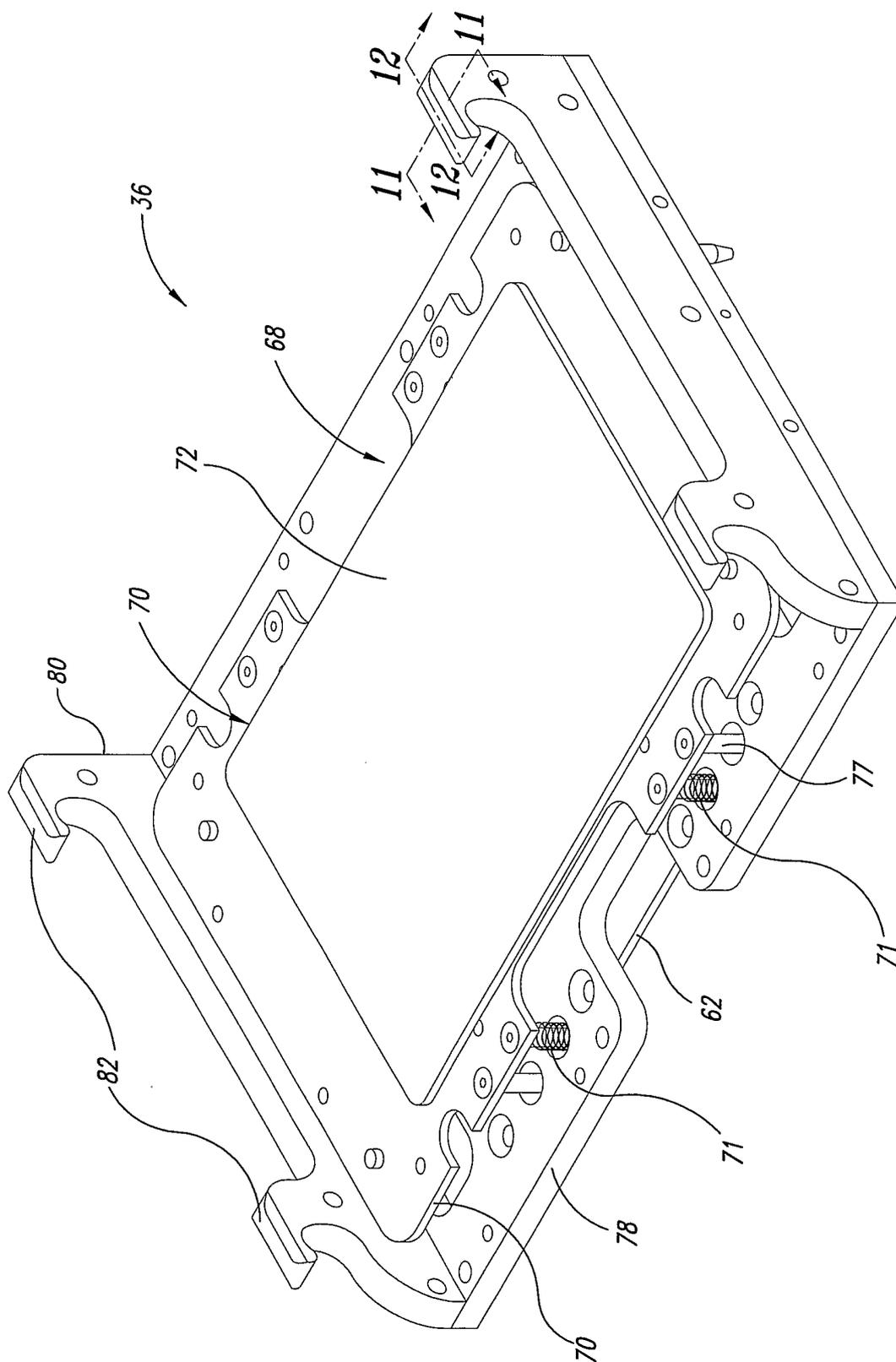


Fig. 6

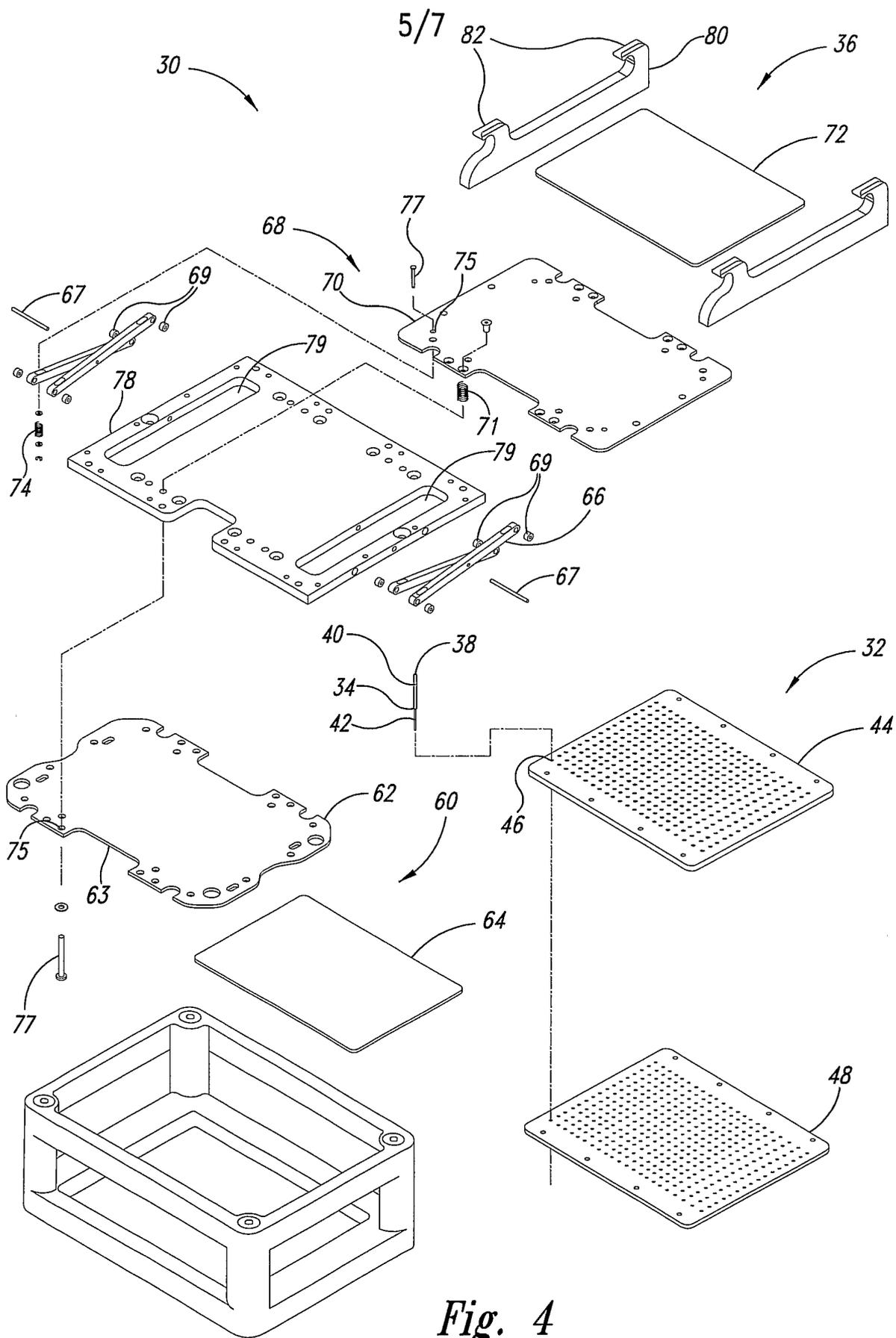


Fig. 4

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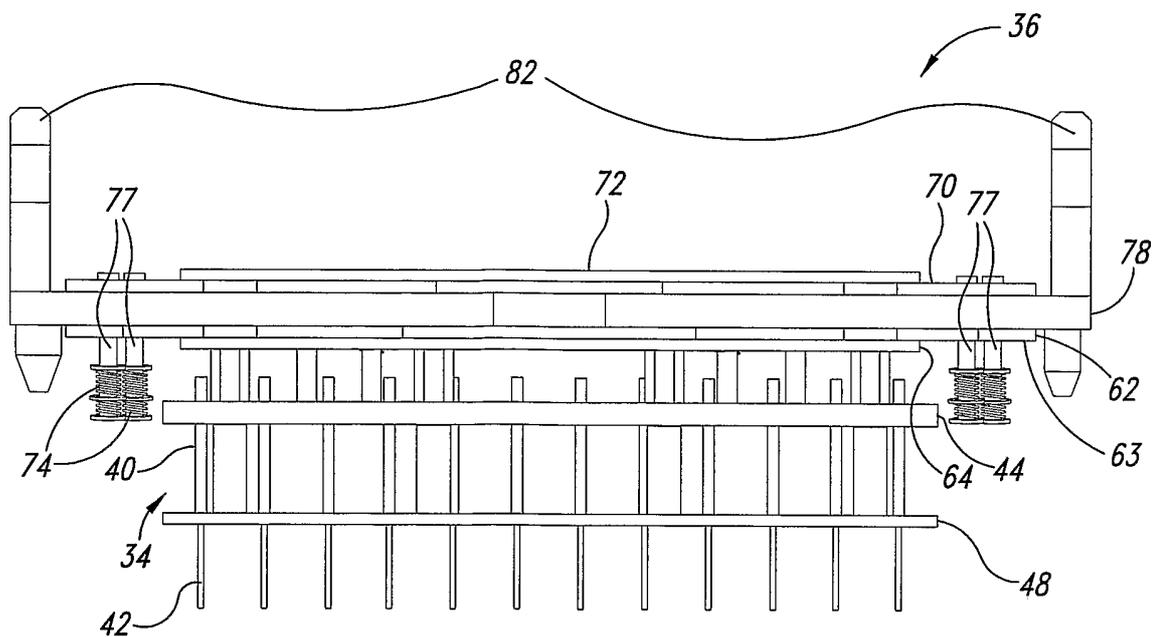


Fig. 7

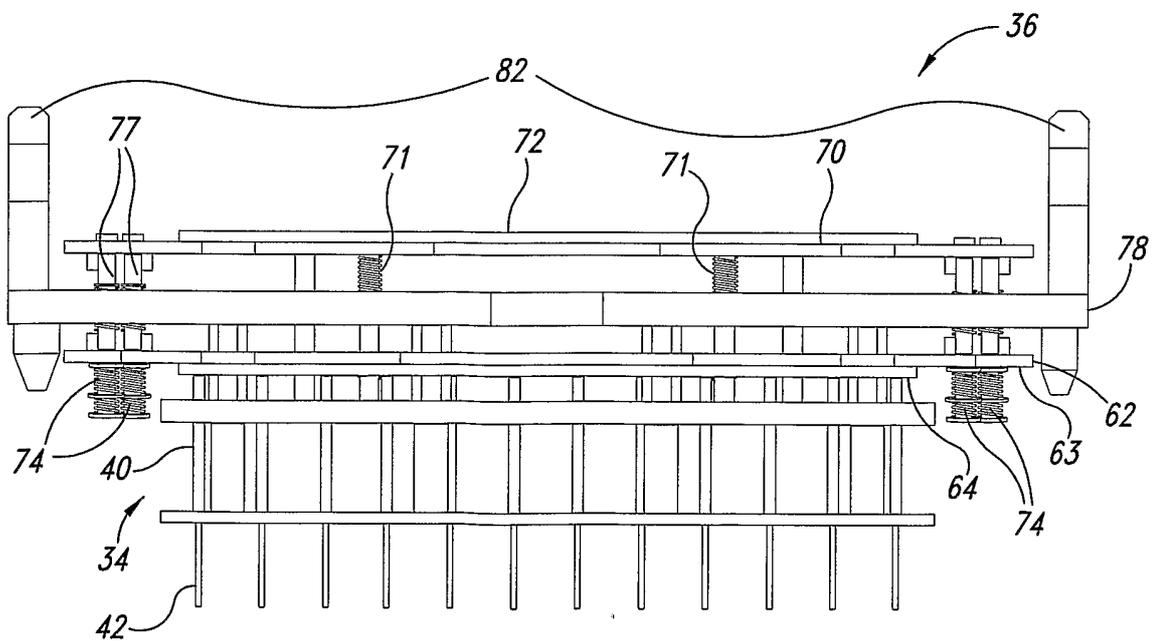


Fig. 8

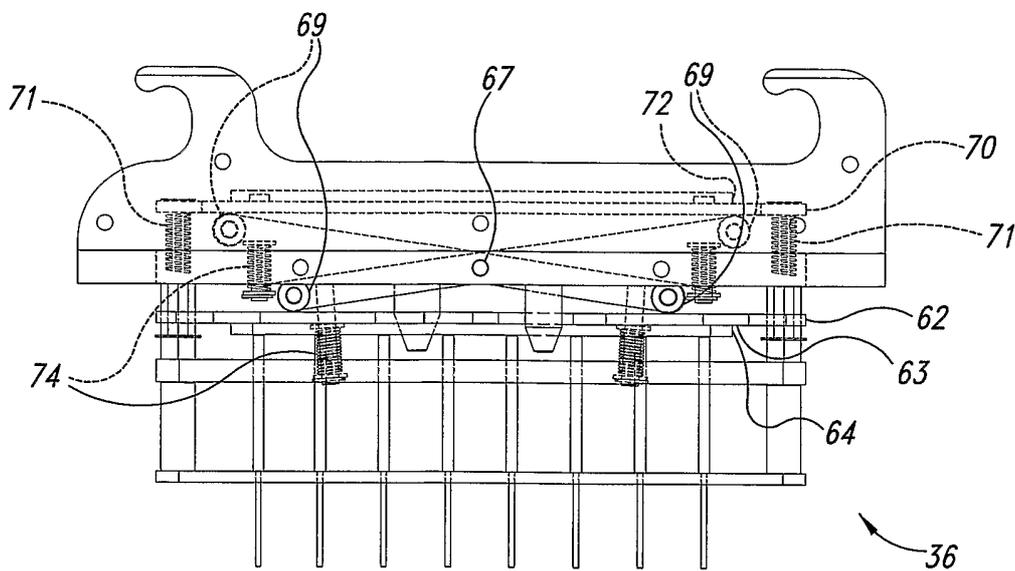


Fig. 9

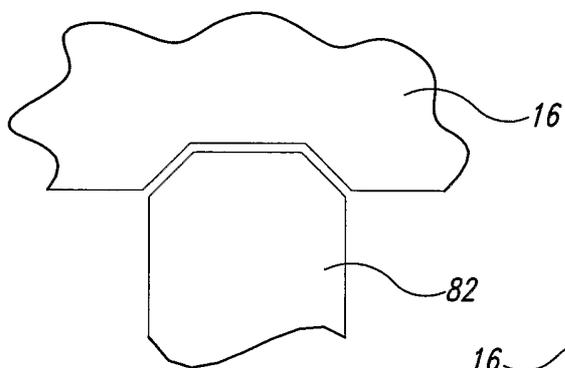


Fig. 11

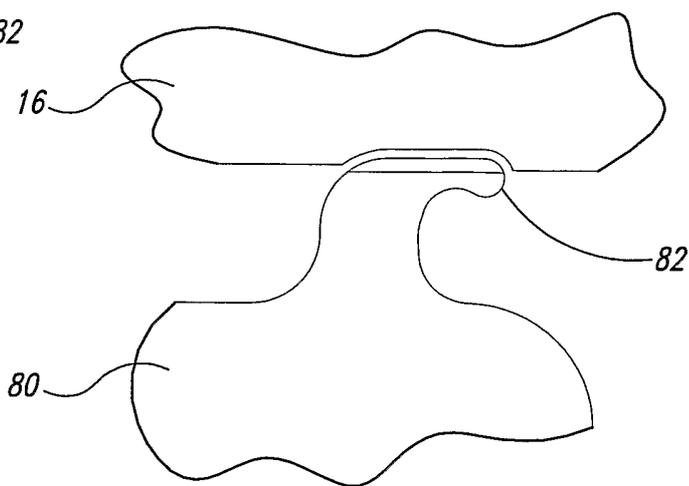


Fig. 12

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/23954

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B01L3/02 G01N35/10 B01L9/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B01L G01N

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 2001/049149 A1 (KENNEDY CRAIG M ET AL) 6 December 2001 (2001-12-06) the whole document	1-33
X	US 2002/072068 A1 (NAKAO MOTONAO ET AL) 13 June 2002 (2002-06-13) paragraphs '0009!-'0017!', '0034!-'0036!; figures 1-4	1-3,5, 10,30-33
A	US 6 101 946 A (MARTINSKY RICHARD S) 15 August 2000 (2000-08-15) column 1, line 45 -column 4, line 22; figure 1 column 7, line 29 -column 7, line 60 -/--	1-33

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Date of the actual completion of the international search

16 December 2003

Date of mailing of the international search report

02/01/2004

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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