

[54] **APPARATUS FOR INSERTING SMALL ARTICLES IN A MATRIX PLATE**

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[58] Field of Search.... 29/208 R, 211 R, 203 V, 211
M, 29/DIG. 46, DIG. 44

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[57] **ABSTRACT**

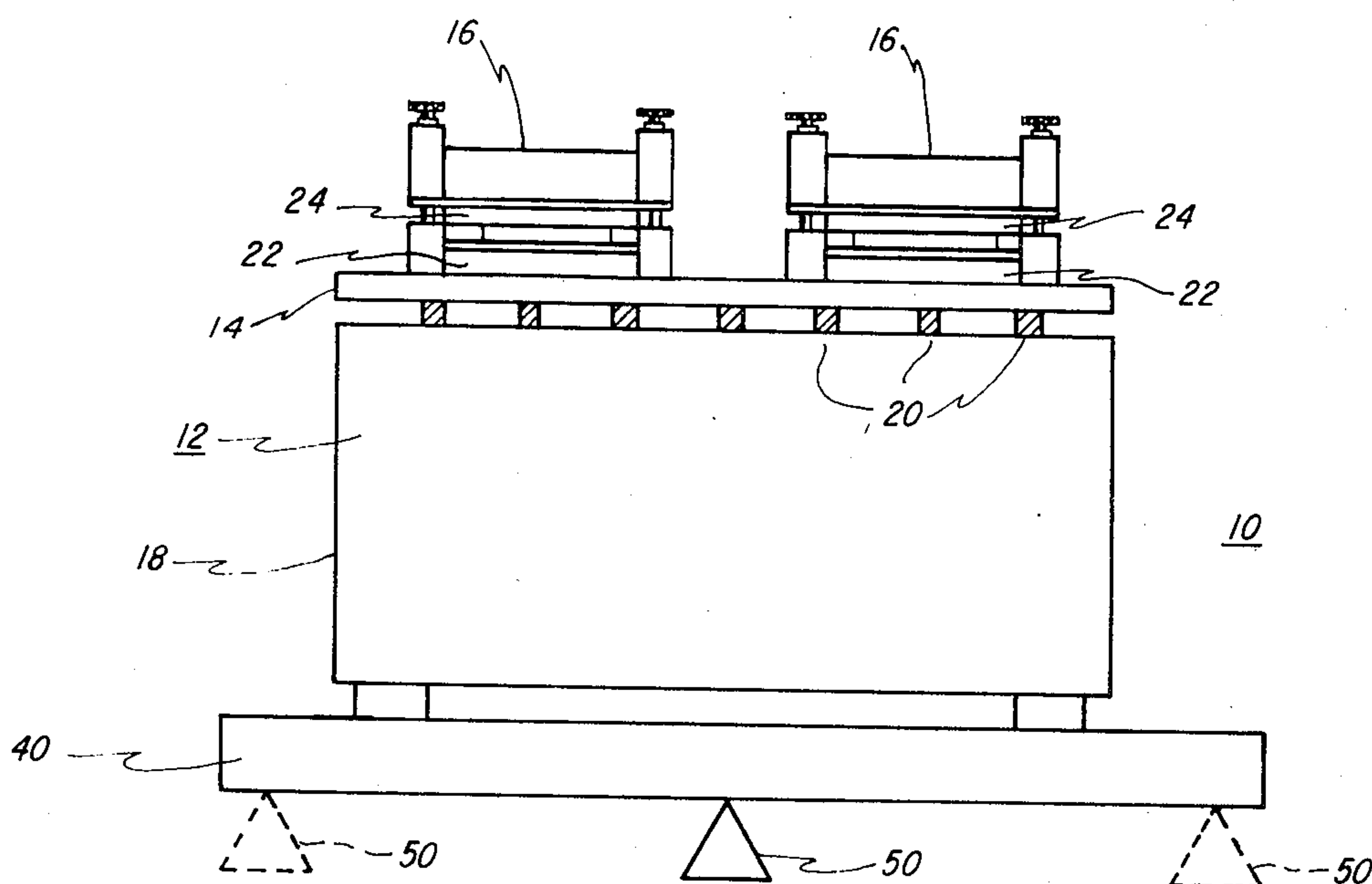
A matrix plate, formed with a plurality of apertures for receiving elongated articles therein, is mounted on a vibration machine. A honeycomb assembly having a plurality of cells is mounted on the matrix plate. Each cell has a preferred dimensional configuration to enhance the tumbling action of the elongated articles as they are walked from one cell to the next adjacent cell as well as to orient the articles in an erect position for insertion into the apertures of the matrix plate.

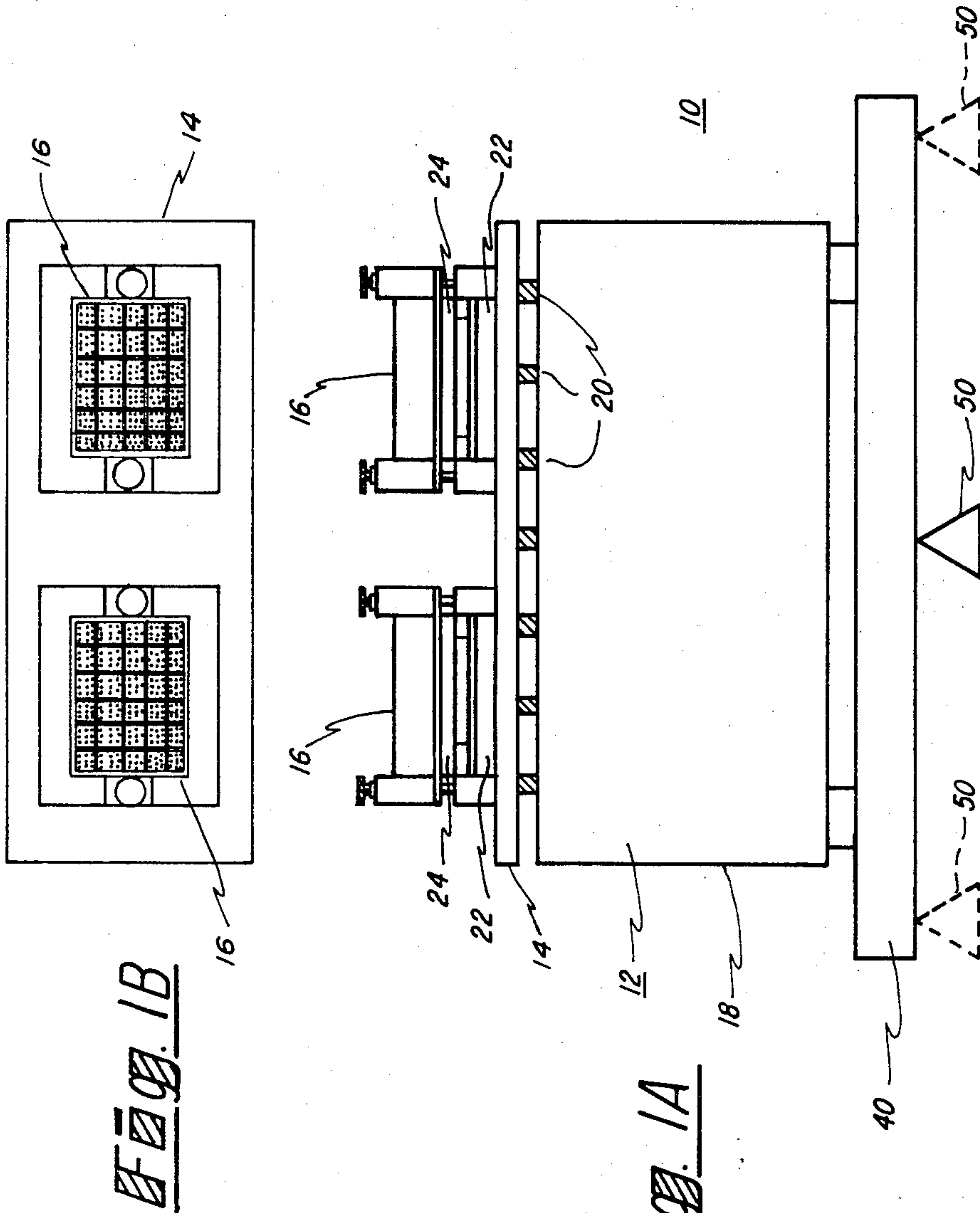
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10 Claims, 6 Drawing Figures





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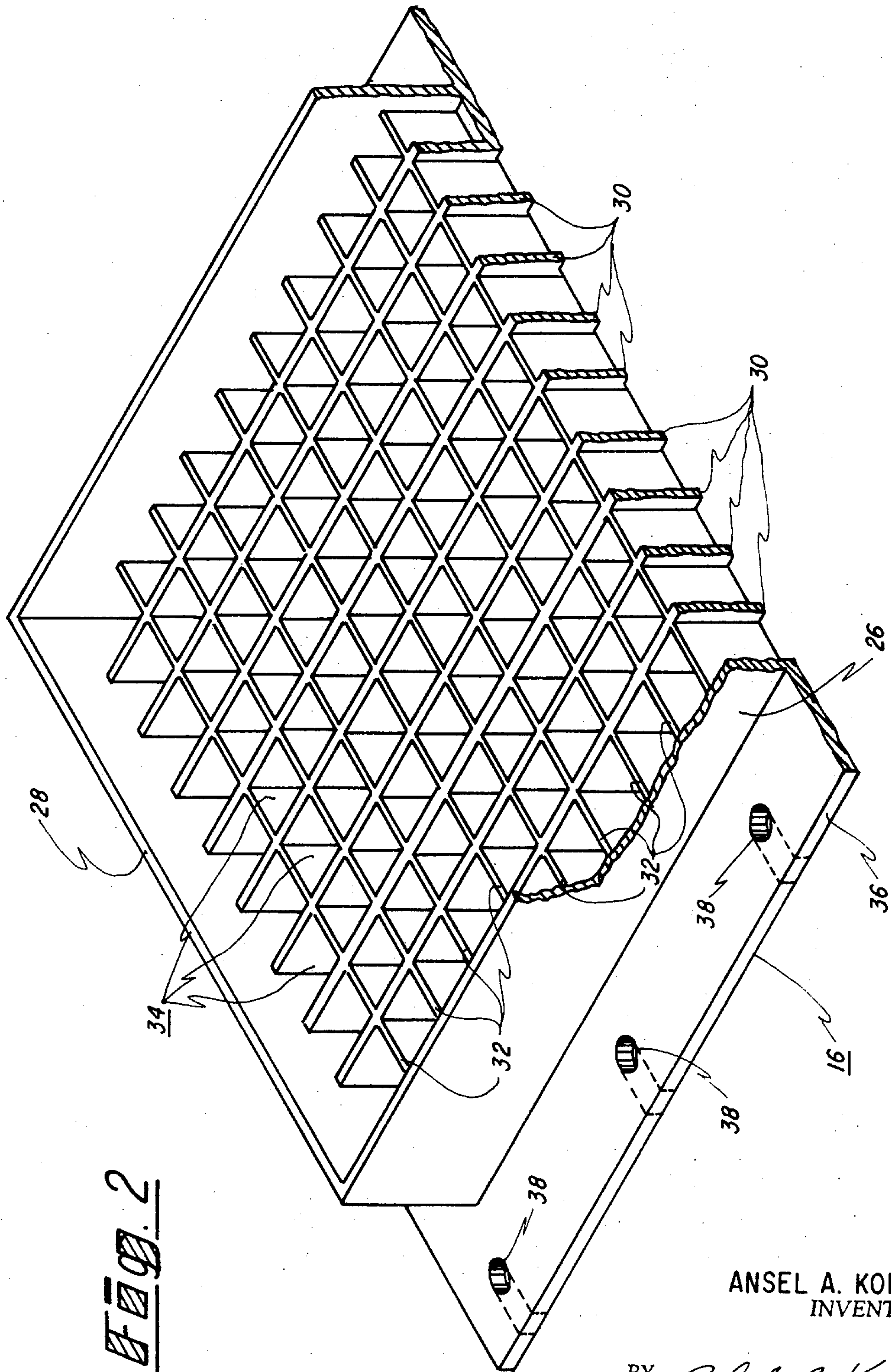


Fig. 2

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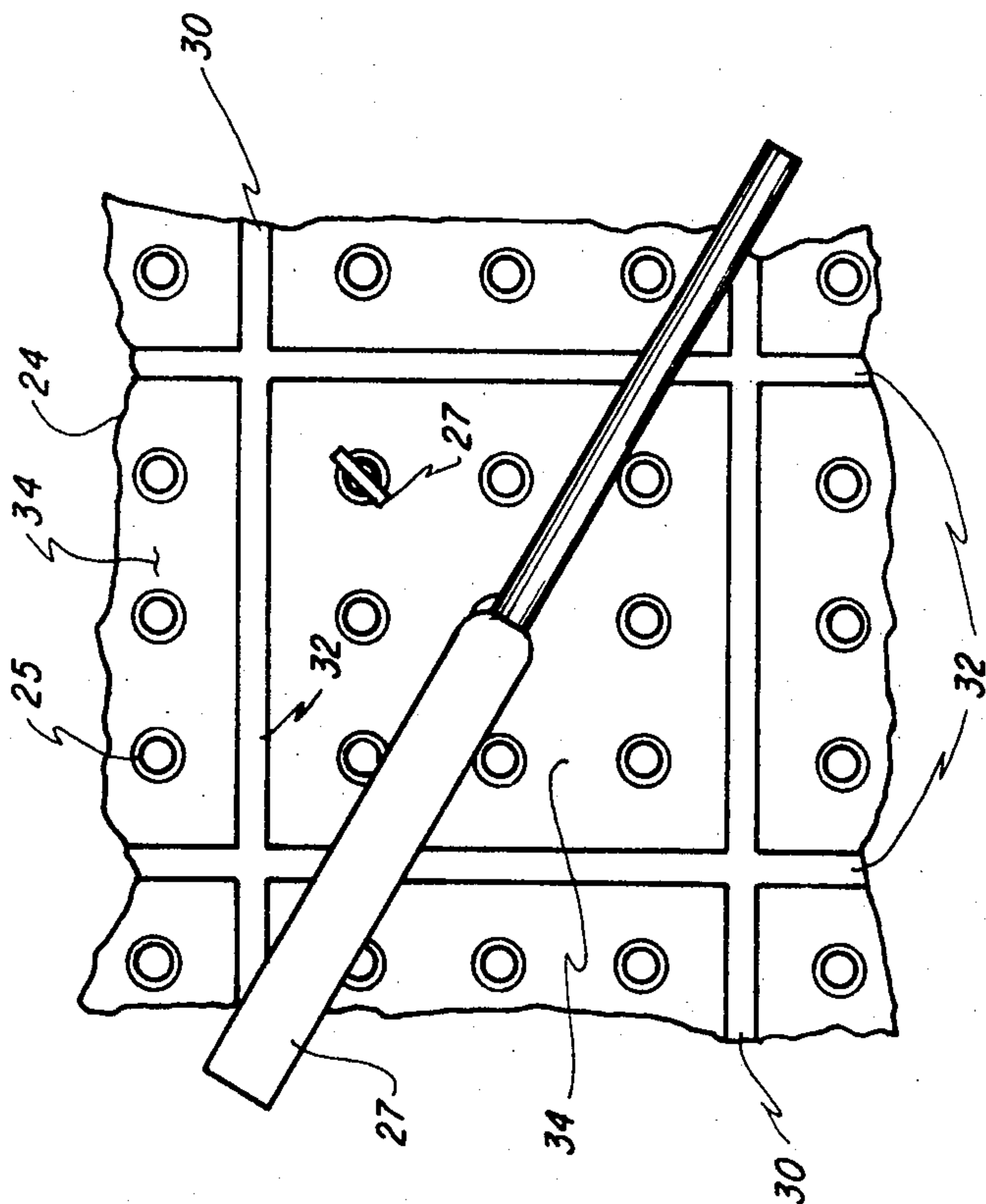


Fig. 3

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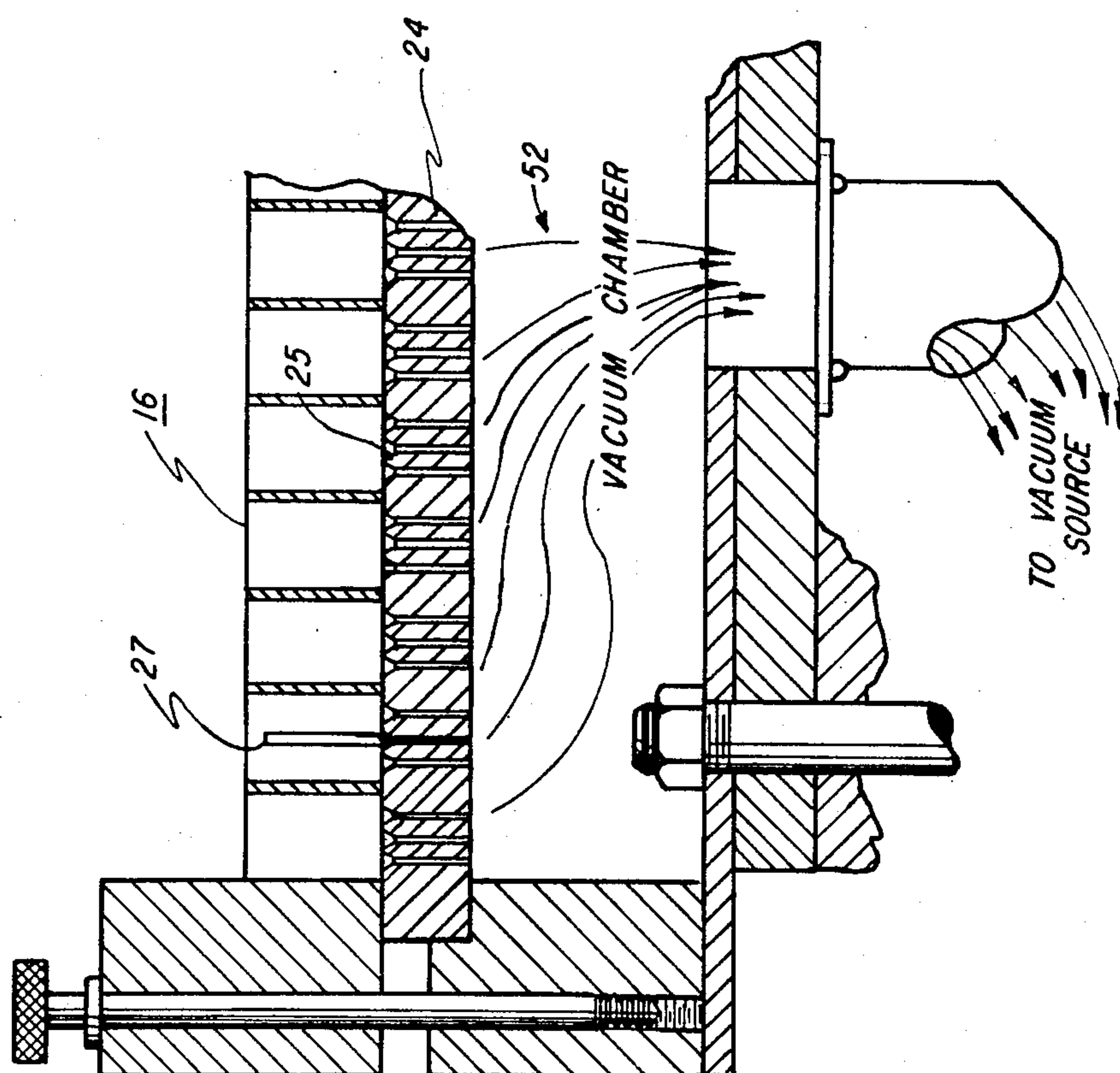


Fig. 4

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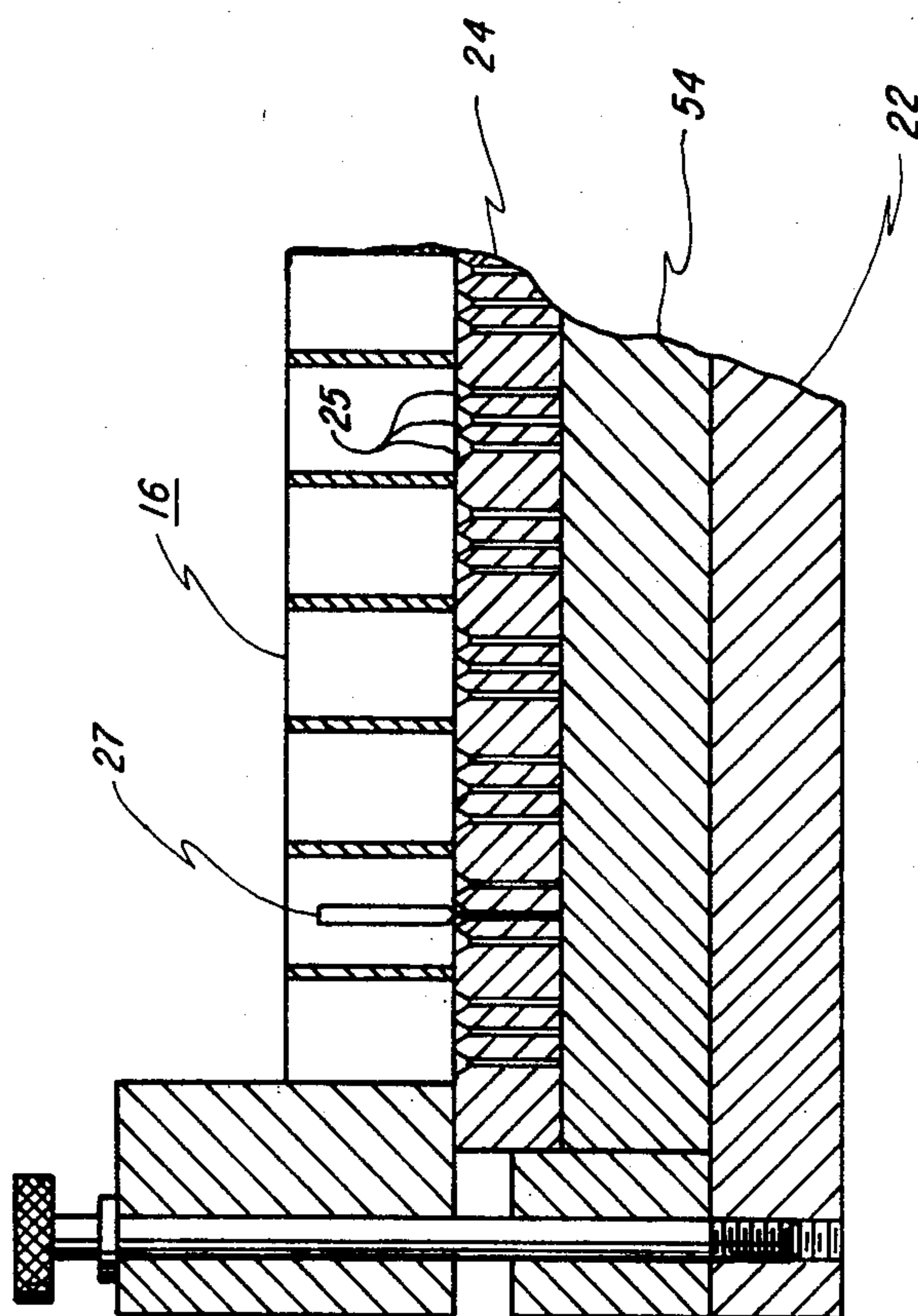


Fig. 5

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APPARATUS FOR INSERTING SMALL ARTICLES IN A MATRIX PLATE

BACKGROUND OF THE INVENTION

1. Field of Invention

This invention relates to apparatus for inserting small articles into a matrix plate having a large plurality of apertures disposed on closely spaced centers.

2. Description of the Prior Art

Heretofore, the assembly of small articles into a matrix plate having a large plurality of apertures disposed on closely spaced centers has proven to be quite time consuming when performed manually and/or incapable of handling all shapes and configurations if performed by mechanical means. One prior apparatus described on pages 20 and 21 of the October 1968 issue of Western Electric Engineering, employs a vacuum chamber disposed beneath a template, or matrix plate, having a plurality of apertures therein. Small articles of uniform cross-section throughout its length, such as the contacts of glass reed switches, are disposed on the top surface of the template and through the utilization of a combination of the vibratory motion and the vacuum created beneath the template, the articles are inserted into the apertures. However, this apparatus and the process utilizing the apparatus fails to perform the accepted standards when the articles being assembled each have different end configurations. The apparatus fails to provide suitable means for assisting the articles into an erect position for insertion into the apertures. Additionally, no suitable means is provided to orient the articles preferentially with respect to the apertures. The apparatus also fails to incorporate any means to aid the articles in tumbling end over end to and fro across the template. Vibratory feed mechanisms co-operating with indexing of the template, or matrix plate, whereby each aperture is individually filled automatically by the vibratory feed mechanism has proven time consuming because of frequent jamming of the articles in the feed mechanism. In addition, the mechanism and process has proven unreliable because irregular feeding by the apparatus leaves apertures unfilled by the mechanism.

It is an object of this invention to provide a new and improved apparatus for assembling articles in a matrix plate having a plurality of apertures therein disposed on closely spaced centers.

A further object of this invention is to provide a new and improved apparatus embodying means suitable for causing articles to "walk" in a tumbling fashion end over end across a matrix plate, thereby enhancing the probability of proper orientation of the articles for inserting into the apertures of the matrix plate.

It is still a further object of this invention to provide a new and improved apparatus for assembling articles in a matrix plate wherein a honeycomb assembly is embodied to promote the "walking" and tumbling action of the articles to enhance the probability of proper orientation of the articles and to decrease the total assembly time.

BRIEF DESCRIPTION OF THE INVENTION

In accordance with the teachings of this invention there is provided apparatus for assembling articles in a matrix plate having a plurality of apertures therein. The apparatus comprises a base and a means coupled to the

base for imparting a vertical reciprocating motion to the base. A matrix plate is disposed on the base. A honeycomb assembly having a plurality of cells is disposed on the matrix plate. Each cell of the assembly has one end disposed about the opening of at least one aperture of the matrix plate. When a plurality of articles are thereafter disposed on the honeycomb assembly, the vertical reciprocating motion imparted to the base causes the articles to tumble end over end. The honeycomb assembly aids in orienting the articles to enhance the probability of inserting the articles in the apertures of the matrix plate.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a simplified block diagram in side elevation of apparatus and FIG. 1B is a top planar view of apparatus made in accordance with the teaching of this invention;

FIG. 2 is an isometric view, partly in cross-section, of a honeycomb assembly made in accordance with the teachings of this invention;

FIG. 3 is a planar view of a portion of the honeycomb assembly of FIG. 2 disposed on a matrix plate;

FIG. 4 is an elevation view, partly in cross-section, of a modification of the apparatus of FIG. 1, and

FIG. 5 is an elevation view, partly in cross-section, of another modification of the apparatus of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIG. 1, there is shown a vibratory loading apparatus 10. The apparatus 10 comprises a vibratory base 12, a vibratory table 14, a matrix plate 24 and a honeycomb assembly 16.

The vibratory base 12 comprises a housing 18 within which is disposed means for imparting a variable vertical reciprocating motion to the vibratory table 14. A suitable means for imparting a variable vertical reciprocating motion to the vibratory table 14 comprises an electromagnet. The electromagnet may be operated on such, for example, as a 60 cycle frequency and the amplitude of vertical displacement of the table 14 is controlled by such suitable means as a rheostat.

The vibratory table 14 is disposed on the vibratory base 12. A plurality of springs 20 are disposed between the table 14 and the base 12 to transmit the oscillatory vertical displacement motion to the table 14. The table 14 may be made of any suitable metallic or non-metallic material which is able to support articles supported on the table 14 at rest as well as when in operation. Suitable materials for comprising the table 14 are steel sheet and/or plate stock and wood.

Most often a base plate 22 is fastened by such suitable fastener means as by nuts and bolts to the vibratory table 14. Disposed upon the base plate 22 is a matrix plate 24 which is fastened to the base plate 22 by such suitable fastening means as a quick release clamp or a swivel bolt and wing nut assembly. The matrix plate 24 is a flat plate formed with a plurality of apertures 25 into each of which an article is to be inserted and retained for further processing in a manufacturing operation. The honeycomb assembly 16 is disposed on the matrix plate 24 and fastened to it by such suitable means as a quick release clamp or a swivel bolt and nut assembly. Alternately, the matrix plate 24 and the

honeycomb assembly 16 may be fastened to each other and to the base plate 22 at the same time by the same fastening means.

Referring now to FIGS. 2 and 3, side and end members 26 and 28, respectively, of the honeycomb assembly 16 enclose a plurality of intersecting longitudinal and transverse members 30 and 32, respectively. As shown, the longitudinal members 30 are disposed substantially parallel to opposed sides 26 and normal to the transverse members 32 which are disposed substantially parallel to opposed ends 28. The intersecting members 30 and 32 form a plurality of cells 34. Additional cells 34 are formed by the intersection of members 30 and 32 with the side and end members 26 and 28, respectively. A flange member 36 having round or slotted apertures 38 therein is affixed to the respective side and end members 26 and 28 for affixing the assembly 16 to the matrix plate 24.

Each cell 34 preferably has a plurality of apertures 25 of the matrix plate 24 exposed in an end portion thereof. Although only one aperture 25 may be exposed within a cell 34, the economics of such an arrangement may prove to be too undesirable. Each aperture may be countersunk to enable the article to be more readily inserted into an aperture 25 formed in the matrix plate 24. The assembly 16 is particularly suited for the insertion of an article 27 into an aperture 25 wherein the article 27 is preferentially oriented. When the article 27 is shaped differently at both ends, the aperture 25 is designed to readily accept one end and to reject the other end of the article 27.

The assembly 16 is made to function in several various ways to aid the insertion of an article 27 into an aperture 25 of the matrix plate 24. The cell 34 is to assist in causing the articles 27 to be aligned in a generally erect position whereby if the article 27 is oriented correctly, its insertion into an aperture 25 is greatly enhanced. The height of each cell 34 must be sufficient enough to prevent an inserted article 27 from being ejected completely from an aperture 25 once it is inserted therein. The height of each cell 34 is such that any articles 27 which for one reason or other are not inserted into apertures 25 in an area defined by one end of one cell 34 can be "walked" in a tumbling action from one cell to the next adjacent cell. This action is to be repeated until substantially all of the apertures 25 are filled. The excess articles 27 are then removed and the remaining unfilled apertures 25 have articles 27 inserted therein manually.

By having a preferred cell length, the walls thereof, in conjunction with the reciprocating vibratory vertical oscillation, cause the article 27 to tumble end over end into the next adjacent cell. This movement into the next cell is what is meant by the term "walking." The length of the cell must be such that it will aid in supporting the article 27 in an erect condition, and cause the article 27 to tumble end over end when it "walks" from cell to cell. If the length is too small, the article 27 may not tumble but jump the wall. By tilting the assembly 16 or the whole apparatus 10, the articles 27 can be "walked" to and fro across the width and length of the assembly 16 in any direction to enable one to increase the rapid insertion of a plurality of articles 27 into the plurality of apertures 25 in the plate 24.

The desirable dimension of the cells 34 include cell sides, which comprise in part portions of members 30 and 32, being of a width in the approximate range of from 37 percent to 47 percent of the length of the article 27 being inserted in the apertures 25. Additionally, the length of the cell is in the approximate range of from 51 percent to 61 percent of the length of the article 27 to be inserted in an aperture 25.

These dimensions for constructing the cells 34 are desirable to prevent an article 27 from becoming wedged diagonally within a cell 34. Wedging of an article 27 in such a manner in all likelihood would prevent the filling of all the apertures 25 in the matrix plate 24, since the article 27 is prevented from being "walked" across the assembly 16 for insertion into an unfilled aperture 25. Additionally, the height of the cells 34 enables the article 27 to be more susceptible to tumbling end over end into the next adjacent cell 34.

The amplitude of vertical vibratory displacement is adjustable to impart sufficient vertical displacement to the articles causing them to tumble end over end over the walls of cell 34, thereby "walking" the articles 27 into the next adjacent cell 34, the end locations of the articles being reversed from the previous orientation that existed in the prior cell. However, an increase in amplitude to aid the tumbling and "walking" action of the articles increases the probability of ejecting an article from the aperture 25 into which it has already been seated. Additional time may then be required to insert the same or another article into the vacant aperture should the ejected article not be reinstated immediately. The magnitude of the amplitude which is best to employ is correlated to and dependent upon the desirable length of each cell. Should the length of the cell be too short and the magnitude of the amplitude too great, tumbling of the article 27 from one cell 34 to another may be impaired or may not even occur as the article 27 may be projected out of the aperture 25 and the cell 34, over the low wall, and into the next adjacent cell 34 landing on the same end as it was resting on previously in the prior cell 34. The tumbling action of the articles 27 as they are walked across the assembly 16 in all directions must be achieved to maintain the high degree of probability of inserting the article 27 into one of the plurality of apertures 25 formed in the matrix plate 24 in the least amount of time.

The configuration of the cell 34 may be of any geometrical shape such, for example, as a rectangle, a circle or a triangle, provided the same relationship is retained between the dimensions of the cell 34 and the article 27 to be inserted into the apertures 25 of the matrix plate 24.

To assist in the removal of excess articles from the honeycomb assembly 16, it is often desirable to fabricate the assembly 16 larger in area than the surface of matrix plate 24 to which it is assembled. This enables one to cover, or block out, the bottom surface area of one or more rows and/or columns of cells 34 immediately adjacent the side and end members 26 and 28, respectively. At the end of the assembly operation most of the excess articles will be retained in these blocked off cells and can readily be removed when the assembly 16 is removed from the plate 24. Any excess articles lying on the surface of the plate 24 may easily be removed by hand or by use of a small vibratory ac-

tion and a slight tilting of the plate 24 to "walk" the excess articles off the plate 24. Any apertures in the matrix plate 24 remaining unfilled are filled manually.

To assemble the articles in the apertures of the matrix plate 24, it has been found that an excess of articles, equal to approximately 50 percent of the apertures in the matrix plate 24, enables one to fill the greatest number of apertures, with the least amount of manual labor to complete filling of the apertures in the least amount of elapsed time. If the excess of articles exceeds 50 percent by too great a figure, it has been found that apertures are plugged up by two articles trying to fill the same aperture, interference occurs between the articles, and the "walking" mobility of the articles is greatly diminished.

To assist the "walking" of the articles to and fro across the honeycomb assembly 16, the vibratory base 12 can be modified to supply means to impart an oscillatory motion to the base 12. A suitable means for imparting the oscillatory motion to the base 12 is to mount the base 12 on a tilt base 40 and tilt the tilt base 40 and the shaker base 12 either via a centered fulcrum 50 or by placing a fulcrum 50 under either end of the base 40. Tilting of the base 40 is accomplished manually or with mechanical assistance.

The process as described and embodying the apparatus made in accordance with this invention and embodying the honeycomb assembly 16 consistently requires less than one-half of one percent of the articles to be placed in the apertures of the matrix plate 24 manually. As an example of the improvement of loading articles by this vibration apparatus, reeds having one end flattened and the other end circular or rod-like in shape as shown in FIG. 3 as item 27 were previously loaded by vibratory action of another type which embodied the sequential indexing of the matrix plate. The process required 40 minutes of machine apparatus time to fill approximately 75 percent of 2,016 apertures in a matrix plate. An additional 30 minutes was required to manually fill the empty apertures with reeds. Employing the process and apparatus of this invention, no more than 7 minutes machine time is required to fill in excess of 2,000 apertures of a matrix plate. The remaining apertures, 10 or less, are filled manually within a few minutes each time. This shows a considerable savings in time and effort by employing the apparatus of the honeycomb assembly of this invention. Additionally, since the reeds are very fragile and easily damaged, the increase in product quality and a very noticeable decrease in damaged material has resulted.

Other embodiments of the apparatus 10 employ suitable means such, for example, as vacuum means and magnetic means in conjunction with the honeycomb assembly 16 to aid in the insertion of articles 27 into the apertures 25 of the matrix plate 24. Referring now to FIG. 4, a vacuum chamber 52 is formed beneath the matrix plate 24. The operation of a vacuum source, not shown, produces a region of reduced pressure beneath the plate 24 which helps retain in place the articles 27 inserted in the apertures 25. This use of a vacuum chamber 52 permits one to employ an amplitude of greater magnitude in causing the articles to tumble and walk from one cell 34 to the next adjacent cell 34. Removal of the vacuum source is accomplished prior to removing the assembly 16 and

the matrix plate 24 and the articles 27 inserted therein from the apparatus 10.

When the articles to be inserted into the apertures 25 are of a magnetic material, the apparatus 10 may be modified to include a magnetizable plate to retain the articles inserted in the apertures 25. With reference to FIG. 5, a magnetizable plate 54 is assembled in the apertures 10 between the matrix plate 24 and the base plate 22. The plate 54 is magnetized during operation of the apparatus 10 so that when an article 27 is inserted in the apertures 25 of the matrix plate 24, it is retained in place by the magnetic force of the plate 54. This permits one to employ an amplitude of greater magnitude than usual to insert the articles 27 into the apertures 25. The magnetizing force of the plate 54 is removed before the matrix plate 24 and the articles 27 inserted therein are removed from the apparatus 10.

What is claimed is:

1. Apparatus for assembling articles in a matrix plate having a plurality of apertures formed therein comprising:
 - a base;
 - means coupled to said base for imparting a generally vertical reciprocating motion to said base;
 - a matrix plate formed with a plurality of apertures therein disposed on said base, and
 - a honeycomb assembly having a plurality of cells disposed on said matrix plate whereby an end of each of said plurality of cells of said assembly is disposed about at least one of said plurality of apertures of said matrix plate.
2. The apparatus as defined in claim 1 wherein: said honeycomb assembly comprises side and end members defining an enclosed perimeter, and walls defining said plurality of cells within said enclosed perimeter wherein each wall of said plurality of cells has a height equal to from 51 percent to 61 percent of the length of an article to be assembled by said apparatus and each cell has a geometrical configuration which can be inscribed within a square having side dimensions of from approximately 37 percent to 47 percent of the length of the articles to be assembled by the apparatus.
3. The apparatus as defined in claim 1 wherein: said reciprocating motion imparted to said base can be varied.
4. The apparatus as defined in claim 2 wherein: said honeycomb assembly comprises each of a plurality of cells immediately adjacent to at least one of said side and end members having that end immediately adjacent said matrix plate closed off to block passage of articles therethrough.
5. The apparatus as defined in claim 2 including: means coupled to said base for imparting an oscillatory motion in a generally vertical direction thereto.
6. The apparatus as defined in claim 4 including: means coupled to said base for imparting an oscillatory motion in a generally vertical direction thereto.
7. The apparatus as defined in claim 5 wherein: said geometrical configuration is a square.
8. The apparatus as defined in claim 6 wherein: said geometrical configuration is a square.
9. The apparatus as defined in claim 4 including:

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vacuum means associated with said matrix plate for
aiding in the retention of articles inserted within
the plurality of apertures of said plate.

10. The apparatus as defined in claim 4 including:
magnetic means associated with said matrix plate for 5
aiding in the retention of articles inserted within
the plurality of apertures of said plate.

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