

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 086 910
A1

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 82300866.9

(51) Int. Cl.³: **A 43 D 1/00**
A 43 D 39/00

(22) Date of filing: 22.02.82

(43) Date of publication of application:
31.08.83 Bulletin 83/35

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI NL SE

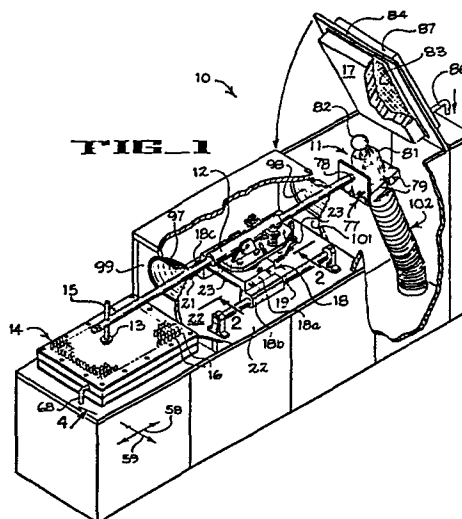
(71) Applicant: **AMFIT INC.**
233 Weddell Drive, Suite H
Sunnyvale California 94086(US)

(72) Inventor: **Curchod, Donald B.**
23555 Mt. Eden Road
Saratoga California 95070(US)

(74) Representative: **Oliver, Peter A.**
8 Coombe Close
Frimley Surrey GU16 5DZ(GB)

(54) System and method for forming custom-made shoe insert.

(57) A system and method for forming a custom-made resilient insert for a given person's shoe in which the contour of the support surface of the insert conforms to the contour of the undersurface of a person's foot.



EP 0 086 910 A1

- 1 -

SYSTEM AND METHOD
FOR FORMING CUSTOM-MADE SHOE INSERT

This invention pertains to a system and method for forming a custom-made insert for a person's shoe.

Heretofore, certain thin, soft pads have been inserted into a person's shoe in order to make the shoe
5 somewhat more comfortable. However, these pads have typically been flat on both top and bottom or preformed to an average foot.

The present invention provides a system for forming a custom-made insert for a given person's shoe in
10 which the contour of the support surface of the insert is shaped to substantially correspond to the contour of the undersurface of the person's foot, characterized in that said system comprises shaping means for shaping a blank of material to form an insert, impression means for select-
15 ively forming an impression of the contour of the undersurface of the person's foot, sensing means for sensing the contour of said impression, and drive means for moving said shaping means in response to said sensing means to shape the blank in accordance with said impression.

20 By custom-forming the top (i.e. supporting) surface of a shoe insert to conform to the contour of the undersurface of a persons's foot the insert can become far more comfortable.

In a system as set forth in the last preceding
25 paragraph but one, it is preferred that support means is provided for holding the blank in position to be operated upon by said shaping means.

In a system as set forth in either one of the last three immediately preceding paragraphs, it is preferred that said impression means comprises an array of elements movable between lowered and raised positions, control means
5 for yieldingly urging said elements toward their raised positions against the undersurface of the person's foot, and locking means for thereafter locking said elements in place to form said impression.

In a system as set forth in the last preceding
10 paragraph, it is preferred that said system includes means forming guideways for said elements, said elements are disposed to move in said guideways, and said locking means is operable for urging said elements laterally against said guideways to hold said elements in place.

15 In a system as set forth in the last preceding paragraph, it is preferred that said last-mentioned means comprises inflatable tubing disposed between adjacent columns of said elements for urging said elements laterally into holding engagement with said guideways in response
20 to inflation of said tubing.

In a system as set forth in the last preceding paragraph but five or but three, it is preferred that means is provided for supporting said sensing means to move between retracted and advanced positions lengthwise
25 of said impression, to move from side to side along said impression, and to pivot up and down with the contour of said impression.

In a system as set forth in the last preceding paragraph but four, it is preferred that said support means
30 includes means for receiving the blank, and means for vacuum clamping the blank in place.

The present invention further provides an impression unit for forming an impression of the under-surface of a person's foot to permit shaping of a custom-
35 made insert in accordance with that impression, characterized in that said unit comprises an array of elements movable between lowered and raised positions, control

means for yieldingly urging said elements toward their raised positions against the under-surface of the person's foot to form an impression in accordance with the contour of the undersurface of the person's foot, and locking
5 means for thereafter locking said elements in place to retain said impression.

In a unit as set forth in the last preceding paragraph, it is preferred that said unit includes means forming guideways for said elements, said elements are
10 disposed to move in said guideways, and said locking means is operable for urging said elements laterally against said guideways to hold said elements in place.

In a unit as set forth in the last preceding paragraph, it is preferred that said array of elements is
15 disposed in columns and rows, said means forming guideways includes means forming first and second axially spaced aligned openings receiving said elements, and said locking means is selectively operable for urging said elements against edge portions of said openings to lock said elements
20 in positions conforming to the undersurface of the person's foot.

In a unit as set forth in the last preceding paragraph, it is preferred that said locking means includes inflatable tubing disposed between adjacent pairs of
25 columns for urging said elements laterally into holding engagement with the edge portions of said openings in response to inflation of said tubing.

In a unit as set forth in the last preceding paragraph but three, it is preferred that means is provided
30 for registering the person's foot with respect to a portion of said array of elements.

In a unit as set forth in the last preceding paragraph but four, it is preferred that means is provided for impeding the raising of said elements at positions
35 disposed forwardly of the locus for supporting the ball of the person's foot.

The present invention further provides a blank for forming an insert adapted to be inserted into a shoe, said blank comprising a body of foam rubber generally formed to a predetermined shoe size, said body having a flat bottom surface from heel to toe thereof, a double-sided pressure-sensitive adhesive layer, one side of said adhesive layer being adhered to said flat bottom surface of said body, and a protective removable sheet applied to the other side of said adhesive layer.

10 The present invention further provides a method of forming a custom-made insert for a given person's shoe wherein the contour of the support surface of the insert is shaped to substantially correspond to the negative image of the contour of the undersurface of the person's foot, said method comprising the steps of making an impression of the contour of the undersurface of the person's foot, disposing a blank of material from which the insert is to be formed at a position proximate to said impression, and tracing the contour of the impression while shaping a
15
20 corresponding negative image of that contour in the blank.

Both the system and method can be quickly and easily employed to form a custom-made insert for use in a shoe to spread the shock forces at stress points beneath the foot, and which is suitable for point of sale usage.

25 The system also provides for forming a custom-made insert for a shoe having means for shaping a blank of the insert material in response to sensing the contour of means for selectively making and retaining an impression of the undersurface of a person's foot.

30 There now follows a detailed description which is to be read with reference to the accompanying drawings, of a system, an impression unit, a blank for forming an insert, and a method of forming an insert, according to the present invention; it is to be clearly understood that
35 these embodiments have been selected for description to

illustrate the invention by way of example and not by way of limitation.

In the accompanying drawings:-

Figure 1 shows a diagrammatic perspective view
5 with portions broken away for clarity of a system for forming a custom-made insert, according to the invention;

Figure 2 shows a side elevation section view in enlarged detail taken along the line 2-2 of Figure 1;

Figure 3 shows a plan view in enlarged detail of
10 a portion of the carriage structure shown in Figures 1 and 2;

Figure 4 shows a diagrammatic perspective view in enlarged detail with portions broken away for clarity taken in the region of the enlarged numeral 4 shown in
15 Figure 1;

Figure 5 shows an elevation section view in enlarged detail taken along the line 5-5 of Figure 4;

Figure 6 shows an elevation view in enlarged detail taken along the line 6-6 of Figure 4;

Figure 7 shows a plan view in enlarged detail
20 showing the disposition of a portion of the locking tubing according to the invention;

Figure 8 shows a diagram in plan view of the configuration of the locking tubing, a portion of which
25 is shown in Figure 7;

Figure 9 shows a diagrammatic perspective exploded view of a hinged frame in a fully open position with means for holding a blank thereon in position to be shaped;

30 Figures 10-13 show a diagrammatic, elevation section view of the system as shown in Figure 1 in successive stages of operation for carrying out the method according to the invention; and

Figure 14 shows a diagrammatic plan view accord-
35 ing to another embodiment of the serpentine inflatable locking tube.

Figure 15 shows a diagrammatic perspective view partially broken away and partially exploded according to another embodiment of the invention;

5 Figure 16 shows an enlarged side elevation view of a detail showing the cutting head operating upon a blank carried by the machine of Figure 15;

10 Figure 17 shows an enlarged diagram in elevation section viewed along the line 17-17 of Figure 15 showing a hydraulic system for inflating and deflating the pin support diaphragm;

Figure 18 shows a plan view of an impression taking means with means for registering a person's foot centrally with respect thereto;

15 Figure 19 shows an enlarged perspective detail view of a portion of Figure 18;

Figure 20 shows a side elevation view of a top portion of an impression taking assembly according to the invention;

20 Figure 21 shows a diagram in plan view of a hydraulic system for locking the impression taking pins in a given position;

Figure 22 shows an enlarged section view taken along line 22 of Figure 21;

25 Figure 23 shows a diagrammatic perspective exploded view of a blank to be formed into an insert for a person's shoe;

Figure 24 shows a perspective view of a procedural step in coating or preparing the underside of a blank of the type shown in Figure 23;

Figure 25 shows a diagrammatic perspective exploded view of portions of a blank and an assembly for registering same;

Figure 26 shows a diagrammatic side elevation of a pre-determined shoe size;

- 5 Figure 27 shows a diagrammatic side elevation section view taken along the line 27-27 of Figure 29 showing another embodiment of an impression taking assembly with the pin locking means removed for clarity, according to the invention;
- 10 Figure 28 shows a diagrammatic side elevation section view taken along the line 28-28 of Figure 29 showing another embodiment of an impression taking assembly with the pin locking means removed for clarity, according to yet another embodiment of the invention; and
- 15 Figure 29 shows a diagrammatic perspective view, in reduced scale, of an impression taking assembly according to the invention.

- System 10 comprises a cutting head assembly 11 carried on one end of an elongate operating arm 12 and a tracing
- 20 head 13 having a hemispherical contact surface 13a carried on the other end of arm 12. Tracing head 13 is disposed to cooperate with an impression taking assembly 14.

In general, assembly 14 is characterized by a number of axially movable pins 16 and means for yieldingly urging the pins upwardly to a predetermined position. While pins 16 are in their upwardly disposed positions a person places a foot upon the pins in order to depress the pins in a configuration conforming to the under-surface of the foot. Means for locking pins 16 in their depressed positions is provided whereby tracing head 13 can be moved across all of the pins to simultaneously move cutting head assembly 11 to prepare a blank 17 of foam rubber or other suitable insert material to conform to the contour defined by the configuration of pins 16.

Means supporting operating arm 12 to move longitudinally between advanced or retracted positions and to move laterally from side to side is best shown in Figures 2 and 3 as now to be described.

Means for moving cutting head assembly 11 in response to the movements of tracing head 13, as noted, includes elongate operating arm 12. A carriage assembly 18 supports arm 12. Guide means in the form of spaced parallel guide rails of rods 19, 21 fixed in spaced relation above the top surface of a base plate 22 support assembly 18 for movement therealong. Assembly 18 includes a carriage body 18a formed to span the spacing between rods 19, 21 and to ride therealong. Accordingly, two sides of carriage body 18a are formed with elongate bearing housing portions 18b, 18c. Each portion 18b, 18c includes roller bearings (not shown) serving to support assembly 18 for movement between retracted and advanced positions along rods 19, 21.

Assembly 18 further includes means supporting arm 12 to pivot to move assembly 11 from side to side and to permit tracing head 13 to travel across the configuration of pins 16 of assembly 14. By supporting arm 12 to move its opposite ends from side to side, tracing head 13 can

travel between retracted and advanced positions along various lateral positions disposed from side to side of the top of assembly 14.

5 Accordingly, carriage assembly 18 comprises a bottom plate 23 secured by bolts 24 to the underside of carriage body 18a.

10 An opening centrally of body 18a serves to contain bearing means for pivotally supporting a top plate 26 carrying arm 12. Accordingly, the bearing means comprises lower and upper truncated conical race members 27, 28, disposed with their smaller circumferences in closely spaced confronting relation so as to define a ball race 29 containing ball bearings 31. A groove 30 confronting race 29 serves as the outer ball race.

15 A retaining lip 33 around the interior periphery of the opening in body 18a engages a relatively narrow peripheral flange 32 of member 27.

20 Bolts 24 draw body 18a downwardly toward the top surface of plate 23 and at the same time serve to retain race member 27 thereagainst.

25 Race member 28 includes a peripheral flange 34 disposed upon a felt dust seal 36. Members 27, 28 are held together by means of elongate bolts 37 which draw the bottom member 27 upwardly toward member 28 so as to retain member 27 substantially in a fixed position against lip 33. Member 28 rotates by virtue of the presence of the ball bearings 31.

At the same time bolts 24 hold the entire assembly tightly to the bottom plate 23.

30 The array of pins 16 in assembly 14 is arranged in

columns and rows represented by arrows 58, 59 respectively.

Thus, top plate 26 can pivot to move the ends of arm 12 from side to side to permit the tracing head to be
5 disposed variously among the array of pins 16 while at the same time causing the cutting head assembly 11 to pursue corresponding movements.

In the foregoing system the blank 91 is positioned upside down and reversed from side to side with respect
10 to the impression formed among pins 16 so that as tracing head 13 follows the contour defined by the impression, a corresponding impression will be formed in blank 91. The vertical pivot axis defined through
15 bearing members 27, 28 and pin 52 is disposed substantially half-way between tracing head 13 and cutting head 82 so as to insure a faithful reproduction. As thus
arranged a relatively compact unit can be provided in which the "dust" created from the cuttings or particles
20 derived from the action of head 82 can be easily contained within the chamber surrounding assembly 11.

Means for holding arm 12 at each of a number of various positions corresponding to the columns 58 of pins 16 in
assembly 14 serves to restrict lateral movement of arm 12 during movement of carriage assembly 18 between re-
25 tracted and advanced positions. This insures that all pins 16 will be contacted by tracing head 13 as described further below. Accordingly, the leading edge of top
plate 26 includes a number of notches 38 corresponding
30 to the number of columns of pins 16 disposed laterally of the axis of arm 12.

Bottom plate 23 carries a selectively operable detent assembly 39 comprising a detent element 41 formed with a tapered knife edge portion 41a for engaging each of
teeth 38. A pivot pin 42 carried in a block 51 disposed

upon the top surface of bottom plate 23 supports element 41 for movement between advance and retracted positions as indicated by arrow 43. The right hand end of bottom plate 23 (as shown) terminates in a pair of spaced portions 23a, 23b serving to accommodate the lower end of element 41 therebetween and further serves to support block 51 for pivot pin 42. Block 51 spans across the gap between portions 23a and 23b and is secured thereto from beneath by fastening means such as a screw (not shown). In order to provide additional strength to this portion of bottom plate 23 portions 23a, 23b can be extended and joined at their outer ends in order to define the gap therebetween as a rectangular opening.

15 An air operated pneumatic cylinder 44, pivotally mounted at its left end as shown in Figure 2 by pivot pin 46 carries a clevis 47 on the outer end of piston rod 48.

As thus arranged injection of air into cylinder 44 via an inlet 49 serves to move rod 48 to the right as shown thereby engaging element 41 with an associated notch 38. In this manner top plate 26 becomes locked against lateral movement with respect to bottom plate 23. While plates 23 and 26 are held against lateral movement, tracing head 13 can be moved along the column of pins 16 associated with the notch 38 then engaged by element 41. By stepping from one notch 38 to the next it is possible to insure that head 13 will contact all pins in each given column.

30 Arm 12 pivots up and down whereby tracing head 13 rises and falls with the contour defined by the configuration of pins 16 of assembly 14. Thus, a pivot pin 52 carried by arm 12 and supported at its ends by trunnion plates 53, 54 on top plate 26 supports arm 12 for such movement.

Means as shown in Figure 4 selectively forms a

configuration defining the undersurface contour of a given person's foot. An array of elements such as pins 16 are movable between lowered and raised positions. Means such as the inflatable diaphragm 56 yieldingly
5 urges pins 16 toward their raised positions against the downward force of a given person's foot as shown in Figure 12. The foot disposed thereon serves to depress pins 16 selectively in accordance with the contour of the underside of the foot. Means for locking the pins
10 thereafter in their depressed positions to maintain the defined contour of the undersurface of the foot comprises an elongate inflatable expansive tubing 57 arranged as now to be described.

Pins 16 are guided between their raised and lowered
15 positions by disposing each pin 16 in its own associated pair of axially spaced aligned openings 61, 62 as formed respectively in plates 63, 64. Means for yieldingly urging all pins 16 upwardly to a predetermined degree includes the diaphragm 56 which can be inflated and
20 deflated via the flow passage 66. The bottom end of each pin 16 carries a snap ring 67 having a diameter larger than opening 61 so as to arrest the upward movement of pins 16 under the action of inflating diaphragm 56 to a phantom line position 56' as shown in Figure 6.

25 Means for selectively locking pins 16 in a depressed position under the weight of and in conformity with the contour of a person's foot disposed upon the upper ends of pins 16 comprises an elongate inflatable expansive tubing 57 disposed in a serpentine configuration between
30 adjacent pairs of columns of pins 16 for urging pins 16 laterally to the side of tubing 57 in response to inflation of the tubing. In this manner pins 16 are forced into a holding engagement with the edges of their aligned axially spaced openings 61, 62.

As shown in Figures 4 and 8 tubing 57 is selectively inflated and deflated via the flow passage 68. Tubing 57 includes a number of lengths 57a disposed in a serpentine configuration between adjacent pairs of columns of pins and a pressure balancing branch 57b which is coupled directly from flow passage 68 to the opposite end of the serpentine portions 57a so as to supply and withdraw fluid to all sections of tubing 57 as quickly as possible since both ends of tubing connect to flow passage 68.

10 In order to prevent the inflating tubing 57 from protruding between adjacent pairs of pins 16 elongate thin flat retaining strips or members 69 are disposed on opposite sides of each stretch of tubing 57. All strips 69 are of the same length as all other strips 69. At
15 one end, strips 69 are joined to a spacer block 71 and extend to the back corner of the block. The other end of strips 69 lies alongside a shorter spacing block 73 so as to permit the short lateral loop 72 of tubing 57 to pass between the end wall 74 and the adjacent pair of
20 pins thereto.

Blocks 73 preferably are floating and unattached to the retaining strips 69.

In addition, it has been found advantageous to apply a wedging force to pins 16 to remove substantially all
25 clearance between pins 16 and their guide openings 61, 62 after tubing 57 has been inflated. In this manner pins 16 are believed to be more securely held against axial movement.

Accordingly, as shown in Figure 7 wedge shaped elements
30 76 are loosely disposed to "float" between adjacent pairs of pins 16 whereby upon inflation of tube 57 the retaining strips 69 will be urged against the backside of wedging elements 76 whereby to force them between their associated pairs of pins.

Cutting head assembly 11 serves to shape the contour of the surface of blank 11 in accordance with the configuration of the contour as defined by the configuration of pins 16 after they have taken an impression of the
5 contour of the undersurface of a person's foot. Assembly 11 comprises a support bracket 77 including a transversely disposed mounting plate 78 and a clamp 79 for engaging the housing of a motor 81 for driving a substantially spherical abrasive cutting head 82 of suitable material,
10 such as steel wool, for example.

As shown in the embodiment of Figure 1, means for holding a blank 17 in position to be operated upon by cutting head 82 includes an open mesh screen 83 mounted in a frame 84 hinged to the edge of a top access opening for
15 the cabinet of the system.

Accordingly, frame 84 is lowered to a closed position overlying head 82. Head 82 will be in a position to be moved against blank 17 in accordance with the dictates of the configuration of pins 16. Blank 17 is held in
20 place by applying a suction to the back of blank 17 via the flow passage 86 coupled into a low pressure air chamber 87 open on the side covered by screen 83. As thus arranged the suction applied to blank 17 tends to hold it in place against screen 83 while the cutting
25 head 82 operates against the exposed surface thereof.

Another embodiment for holding the blank in position to be shaped by cutting head 82, as shown in Figure 9, includes one of a series of thin semi-rigid templates 88 each formed with an opening 89 shaped substantially to
30 the shoe size of the person for whom the custom-made insert is being prepared. Short mounting studs 92 carried at the corners of a low pressure air chamber 93 engage openings at the corners of a template 88. Chamber 93 is formed as described above to include an open side
35 covered by an open mesh screen to act as a backing member

to both the template 88 and blank 91 when disposed in opening 89. Also as noted above, the low pressure air chamber 93 is pivotally supported by means of hinge 96.

5 Inasmuch as the cutting head 82 operates at high speed when cutting against the foam rubber surface of blank 17 or blank 91 a substantial quantity of particles is discharged into the chamber where assembly 11 is operating.

10 In order to permit arm 12 to be manipulated as above described and to be isolated from the aforementioned particles, a pair of expansible seals 97, 98 are secured at their inner circumference to arm 12 and at their outer circumference to the end walls 99, 101 forming a portion of the chamber within which assembly 19 operates. At the same time a vacuum is drawn on the chamber containing assembly 11 through the relatively large diameter flexible boot or conduit 102. Conduit 102 supplies a flow of cooling air to motor 81 which not only cools motor 81 but also serves to prevent an inordinate accumulation of cuttings from collecting within motor 81. 15 Further, the supply of air via conduit 102 also assists in increasing the vacuum drawn against blanks 17 or 91 when carried by the hinged frame 84. 20

25 Another embodiment for supplying air to tubing 57, as shown in Figure 14, includes a single length of tubing 103 pinched off at its remote end by means of a clamp 104 while the inlet end is mounted upon the end of an elongate tube 106.

30 Means are further provided for biasing the "cutting" end of operating arm 12 upwardly toward blank 17 or 91 and for urging tracing head 13 downwardly against the top ends of pins 16 to relieve the force required to manipulate arm 12. Accordingly, a U-shaped strap 55 located between pivot pin 52 and assembly 11 serves to carry

arm 12 upwardly as urged by means of compression springs 60. Bolts 65 extend through strap 55 on opposite sides of arm 12 and also extend through plate 26 so as to be able to adjust the action of springs 60 and strap 55.

- 5 In addition to the above, the presence of the spring-loaded strap 55 serves to provide a resilient mounting against which the far end of operating arm 12 can drop so as to prevent damage thereto in the event of an inadvertent release of control handle 15.
- 10 The crown or cutting portion of cutter head 82 has the same arc as tracing head 13 so as to produce a faithful copying of the contour defined by the configuration of pins 16.

Operation of the system described above is illustrated
15 in Figures 10 through 13 as now to be described.

- In Figure 10 it is to be noted that diaphragm 56 lies deflated and pins 16 are randomly disposed. In Figure 11 all pins 16 are moved to a predetermined position by inflating diaphragm 56 via flow passage 107. While
20 maintaining pressure in diaphragm 56 a person's foot 108 is placed downwardly onto the upper ends of pins 16 so as to cause them to yieldingly conform to the contour of the undersurface of the foot. The locking tubing 57 is then inflated in order to hold all of the pins and
25 retain the impression so made. Diaphragm 56 typically remains inflated to assist tubing 57 in holding pins 16 in their depressed positions. With the pins so held in position, tracing head 13 can be moved across the
30 tops of pins 16 to cause cutting head 82 and motor 81 to be moved in accordance with the movements of tracing head 13 to form a blank having a contour corresponding to the contour of the undersurface of a person's foot.

.. 17 ..

In order to obtain a faithful copy of the contour defined by the configuration of pins 16 after they have taken an impression of the contour of the underside of a person's foot using a relatively compact machine, the system arrangement is characterized by disposing the array of pins 16 to extend in one direction, disposing the face of a blank 17, 91 to be operated upon in an opposite direction, employing the opposite ends of an operating arm in working relation to the array of pins 16 and the surface of blank 17, 91 preferably by use of a pivot intermediate the ends of the arm.

While blank 17 is formed as a rectangular block of material it is readily evident that after so forming the contour upon block 17 it can be cut to an appropriate shoe size to form an insert. However, it is believed preferable to commence initially with a blank corresponding substantially to a person's shoe size of the type shown in Figure 9 and an associated corresponding one of a series of templates 88.

The system as described above accordingly carries out the steps of making an impression of the contour of the undersurface of the person's foot. A blank of material of a type from which the insert is to be formed is disposed at a position remote from the impression. The contour of a the impression is traced while forming a corresponding contour in a face of the blank so disposed.

The face of the blank is disposed so as to be directed away from that of the impression.

Finally, for a given person the further step of making another impression of the undersurface of the person's other foot is employed using the same means as used to make the first impression.

While the foregoing system has been disclosed as being an air operated system, it is contemplated that other fluids can be used in a system of the kind described (or with slight variations) such as hydraulic fluids.

5 Thus, according to another embodiment of the invention as shown in Figures 15-25 an insert preparing machine 110 provides a system for forming a custom-made insert for a given person's shoe in which the support surface of the insert conforms to the undersurface of the person's foot
10 with a load applied thereto as desired. The system comprises means serving to form an impression of the contour of the undersurface of the person's foot while a cutting head is operated to relieve materials from a blank in conformance to the impression so made.

15 Accordingly, machine 110 includes a cutting head 111 comparable to cutting head 82 above described. An elongate operating arm 112 carries a support assembly 113 on one end for head 111 to be driven by a rotating cable 115 disposed within the flexible sheath 114. Thus one end of the
20 cable operates head 111 while the other end of cable 115 is coupled to the drive motor 116 disposed behind a partition 117.

As thus arranged, cutter head 111 operates within a collection chamber 118 which serves to collect all of the dust
25 resulting from the cutting operation.

In the manner noted above, a trunion 119 supports control arm 112 for vertical movement while a top plate 121 is supported in bearings to permit lateral movement of arm 112. Longitudinal movement of arm 112 is achieved by the
30 movement of carriage assembly 122 mounted on linear bearings (not shown) for movement along the guide rods 123.

Means serving to form an impression of the contour of the undersurface of a person's foot comprises the impression taking assembly 124 as now to be described, employing an

array 125 of vertically movable pins 134.

Initially, for better understanding of the machine, a hydraulic system is employed to urge pins 134 upwardly to their maximum position. At that point a person standing
5 on the machine will place one foot on the pins for taking an impression. Then the pressure beneath the pins is released so that they fall to their retracted positions. Subsequently hydraulic pressure is inserted back into the diaphragm which urges the pins upwardly as desired. For
10 this purpose a pressure meter 132 is provided so that the load applied to the person's foot can be detected directly. Having thus established a selected "loading" against a person's foot on the pins, they are then locked in place so that they can retain the impression thus made.

15 Thus, as shown in Figure 17 the hydraulic cylinder 126 includes a piston 127 which can be advanced and retracted by movements of a crank 128 operating a threaded drive stem 129 coupled between crank 128 and piston 127.

As can be readily seen from the diagram of Figure 17, as
20 piston 127 advances to the right, the pressure increases in the hydraulic lines 131 as directly detected by meter 132.

The hydraulic liquid 135 discharging from cylinder 126 inflates diaphragm 133 thereby urging pins 134 upwardly to their maximum extent.

25 The force acting against diaphragm 133 for urging pins 134 upwardly is in direct relationship to the pressure within the hydraulic system as read directly by meter 132. Hence, the amount of "loading" applied to a person's foot can be selectively established in this manner so that the
30 insert which is ultimately constructed is based on a selected condition of "loading" against the bottom of the foot.

As shown in Figures 21 and 22 a hydraulic locking system for retaining the pins in a fixed state so as to retain the impression of the contour defined by the undersurface of a person's foot comprises the hydraulic cylinder 136 having a piston 137 movable between advanced and retracted positions by the clockwise and counterclockwise movements of the crank 138 rotating a threaded drive stem 139.

Accordingly, hydraulic pressure can be increased in the hydraulic line 141 as detected directly by the meter 142. As thus arranged, hydraulic fluid is fed under pressure via a common line 143 to both ends of the expansible tubing 144. Thus, liquid quickly enters tubing 144 to apply a lateral pressure to bands 146 whereby pins 134 are urged laterally apart and into engagement with the side edges of their respective openings 147 through which they move.

According to a preferred embodiment, a blank 148 to be formed to provide an insert for a shoe comprises a body 149 of foam rubber generally formed to a predetermined shoe size. The body 149 includes a flat bottom surface 151 extending from heel to toe. Body 149 further includes a relieved region 152 so as to form a relatively thin sole portion 153 to be disposed beneath a person's toes.

In view of the fact that the material of region 152 is to be removed in virtually all instances the blank can be initially formed with the relieved portion 152.

A layer 154 of double-sided pressure sensitive adhesive employs a protective covering 156 of a type adapted to be peeled off to expose the adhesive material therebeneath. Accordingly, protective coverings 156, 157 are shown in a partially peeled back stage in Figure 23.

Before adhering layer 154 to the flat bottom surface 151 of body 149 it has been observed that it is highly useful to spray a light coating of glue 158, as shown in Figure 24,



as from an aerosol can or otherwise onto bottom 151 to provide a light coating thereof upon bottom 151.

5 After glue 158 has become tacky protective covering 156 can be peeled from a side of adhesive layer 154 to expose the adhesive surface. Subsequently, the adhesive surface is applied directly to bottom 151.

As thus arranged a pre-sized blank of material for forming an insert is provided having a bottom surface of adhesive covered by a protective sheet.

10 When it is desired to form blank 148 into an insert for a given person's foot it is evident that the blank must be positioned with respect to the cutting head in a manner corresponding to the registration of a person's foot on the array 125 of pins 134. In short, where the blank 148 is of
15 a predetermined shoe size corresponding to the shoe of a person's foot being disposed on the pins 134, means for registering the person's foot at a predetermined lateral position within the array 125 of pins 134 will be required. Means for correspondingly registering the cutting means
20 (such as cutting head 111) with respect to blank 148 so as to conform to the impression is also provided as now to be described.

A registration assembly 159 comprises an elongate pivot rod 161 carrying a pair of downwardly directed mounting
25 pins 162 adapted to be inserted into associated openings 163 of support a registration member 164 for movement between advanced and retracted positions along rod 161. Member 164 includes a heel receiving portion 164a and a side guide 164b. For a person having a rather narrow foot
30 an additional side guide 166 can be mounted onto the upper edge of side guide 164b by means of a pair of brackets 167 extending from the back side of side guide 166.

As thus arranged, with mounting pins 162 disposed in openings 163 to support pivot rod 161, registration member 164



can be disposed to overlay the array 125 of pins 134 as shown in Figure 18. In this position a set screw 168, when released, serves to permit registration member 164 to move axially along rod 161. After disposing a person's toes in the position shown by phantom line 169, registration member 164 is moved forwardly until the portion 164a engages the heel of a person's foot disposed on the array 125 of pins. At that point set screw 169 can be tightened so as to establish the longitudinal and lateral position of a person's foot 169, the ball of the foot is to be disposed against side guide 166 or 164b depending upon whether the person has a narrow or wide foot, respectively.

At this point the impression of the person's foot is taken in the manner described above by releasing pressure beneath pins 134, then raising the pins to provide a selected load to the underside of the foot. Following this step the pins are then locked in place to retain the impression.

Means for correspondingly registering the cutting means or cutting head 111 with respect to a blank 148 of material to be relieved to conform to the impression taken by pins 134 comprises a hinged panel assembly 171 having a flat mounting surface 172 formed to include a pair of openings for receiving mounting pins 162 therein.

Accordingly, means are provided for properly registering blank 148 onto surface 172. Accordingly, the hinge 173 permits assembly 171 to be laid back whereby registration assembly 159 can be removed from the region of the impression taking means 124 and disposed into assembly 171. Having so oriented the registration assembly 164 and the ball portion of blank 148 disposed against a side guide 166 or 164b, blank 148 can be lowered into adhering engagement with surface 172 to be retained thereon.

Preferably surface 172 is formed of a plastic material 174 whereby the adhesive can retain blank 148 securely thereto but will also permit blank 148 to be peeled therefrom after

it has been formed.

Accordingly, such a surface is shown at 174.

In order to provide stability during an operation, a pair of treads 176 serve to flank the array 125 of pins 134 whereby
5 the person having an insert being made can lift one foot at a time.

As above described an insert for a shoe to be worn on the right foot has been provided. In order to provide an insert for use on a person's left foot registration assembly 159 is
10 repositioned whereby member 164 is pivotally moved about the axis of rod 161 so as to lie on the opposite side of rod 161. At that point, the mounting pins 162 can be disposed into openings 177. As thus arranged, and as shown in Figure 18, registration member 164' is shown in phantom lines where
15 rod 161' is mounted on the opposite side of the array 126 of pins 134.

Finally, a shock absorber 179 serves to dampen lateral movements of control arm 112.

The embodiments shown in Figures 27, 28 can be more readily
20 understood by referring initially to Figure 29 which shows a unit or assembly 184 for taking the impression of the under-surface of a person's foot wherein an array of pins or other extensible elements 186 are yieldingly urged to extend upwardly through associated openings in a base plate 192.
25 While an inflatable diaphragm urges pins 186 upwardly, a person placing his foot onto the upwardly urged pins 186 will depress pins 186 therebeneath in conformity to the contour of the undersurface of the foot.

As explained above, a flow passage 188 supplies fluid (e.g.
30 a mixture of water and lubricant) to tubing 57 for locking pins 186 in place to retain the impression made by the



person's foot placed thereon. Having formed the impression and locked the pins in place, a tracing head 183, manipulated by the control handle 185, serves to move the operating arm 182 as described above.

- 5 Embodiments of Figures 27, 28 provide improved units for taking an impression of the undersurface of a person's foot. Each is characterized by means for progressively increasingly limiting the displacement of those of the pin elements disposed at positions progressively forwardly of the locus
10 for supporting the ball of a person's foot.

It has been observed that when taking the impression of a person's foot the toes provide very little downward force for displacing pins 186 downwardly against the inflated diaphragm 187. Accordingly, the impression taken beneath a
15 person's toes will normally be of insufficient depth due to the failure of the toes to provide enough downward displacement of pins 186 to accurately represent the contour beneath the toes. The embodiments of Figures 27 and 28 compensate for this limitation.

- 20 Thus, means as now to be described, progressively limit the displacement of those of said pin elements 186 disposed at positions progressively forwardly of the locus 189 for supporting the ball of the person's foot. As shown in Figure 27 that group of pin elements 186a disposed at
25 positions progressively forwardly of locus 189 are progressively shortened. A tapered rigid member 191 serves to progressively limit the downward displacement of elements 186a to prevent elements 186a from dropping out of their associated guide openings in plates 192, 193.

- 30 By foreshortening pins 186a and providing the tapered member 191 the person's toes are not required to force pins 186a downwardly to any great degree while at the same time obtaining an accurate representation of the undersurface



contour of the person's foot beneath the toes.

As shown in the embodiment of Figure 27 member 191 comprises a rigid body disposed at the bottom wall of diaphragm 187 beneath those of the pin elements 186a disposed at positions progressively forwardly of the locus 189. The upper surface of body 191 slopes upwardly and forwardly to limit the axial movement of pins 186a to prevent them from dropping out of their associated guide openings in plates 192, 193.

Means for locking pins 186, 186a in their depressed positions is provided as above described and referred to in Figure 27 as the tubing 57' and retaining member 69'. Spacer blocks 73' are also provided at the end, also as above described. These same elements (designated 57", 69" and 73") are also shown in Figure 28 for locking pins 194, 194a in their depressed positions.

Thus, there has been provided means for progressively increasingly limiting vertical displacement of those of the pins disposed at positions progressively forwardly of the locus for the ball of a person's foot to define that portion of the impression made by that portion of the undersurface of a person's foot underlying the person's toes. An array of pin elements 186, 186a as viewed in side elevation and with said elements fully extended upwardly defines a profile having a substantially straight horizontal portion extending generally from the heel region forwardly to the region adapted to underlie the ball of the person's foot. The profile further includes a downwardly sloping portion extending forwardly therebeyond to progressively reduce the degree to which those pins 186a defining the downwardly sloping portion of the profile extend above a reference plane defined by base plate 192. This achieves a significant reduction in the force required to be applied by the toes to pins 186a to create an accurate negative image in the region beneath the toes.

The remaining structure shown in Figure 27 is as previously described including the piston 227 and the connecting line 231 for supplying hydraulic fluid to diaphragm 187. Also, as noted above the rigid midplate 193 serves to confine the
5 upward expansion of diaphragm 187.

Accordingly, it will be readily evident that there has been provided means for taking an impression of the undersurface of the person's foot characterized by an array of elements 186 movable between lowered and raised positions by yield-
10 ingly urging the elements upwardly. Means for disposing the upper ends of the elements to protrude progressively less at positions disposed progressively forwardly of locus 189 serves to reduce the degree of downward displacement of pin elements 186a required to be derived from the downward force
15 applied by the person's toes.

According to another embodiment as shown in Figure 28 all of the pin elements 194, 194a are the same length. However, means for disposing the upper ends of pin elements 194a in a downwardly sloping profile as above comprises a downwardly
20 tapered rigid member 196 which serves to progressively constrict the expansion of diaphragm 197 and displacement of those elements 194a disposed at positions progressively forwardly of the locus 189.

Member 196 includes a number of openings 198 for receiving
25 pins 194a therethrough. Since pins 194, 194a shown in the embodiment of Figure 28 are all of equal length no sorting is required before inserting them into openings 198.

Thus, a rigid panel 202 disposed above diaphragm 197 and a rigid base 201 disposed beneath diaphragm 197 serve to limit
30 expansion of diaphragm 197. Member 196, as shown in Figure 28, slopes downwardly and forwardly to depress the top of diaphragm 197 so as to constrict the expansion thereof in the region lying beneath pins 194a.



From the foregoing it will be readily evident that there has been provided an improved system and method for the custom-making of shoe inserts which will conform exactly to the contour of the undersurface of a person's foot when subjected to a selected degree of pressure, i.e. "loading".

5 The system and method as above described are believed readily suitable for use at the point of sale of shoes and the like since no special training is required.



CLAIMS:

1. A system for forming a custom-made insert for a given person's shoe in which the contour of the support surface of the insert is shaped to substantially correspond to the contour of the undersurface of the person's foot, characterized in that said system comprises
5 shaping means for shaping a blank of material to form an insert, impression means for selectively forming an impression of the contour of the undersurface of the person's foot, sensing means for sensing the contour of
10 said impression, and drive means for moving said shaping means in response to said sensing means to shape the blank in accordance with said impression.

2. A system according to claim 1 characterized
15 in that support means is provided for holding the blank in position to be operated upon by said shaping means.

3. A system according to either one of claims 1 and 2 characterized in that said impression means
20 comprises an array of elements movable between lowered and raised positions, control means for yieldingly urging said elements toward their raised positions against the undersurface of the person's foot, and locking means for
thereafter locking said elements in place to form said
25 impression.

4. A system according to claim 3 characterized in that said system includes means forming guideways for said elements, said elements are disposed to move in said
30 guideways, and said locking means is operable for urging said elements laterally against said guideways to hold said elements in place.

5. A system according to claim 4 characterized in that said last-mentioned means comprises inflatable tubing disposed between adjacent columns of said elements for urging said elements laterally into holding engagement with said guideways in response to inflation of said tubing.

6. A system according to either one of claims 1 and 2 characterized in that means is provided for supporting said sensing means to move between retracted and advanced positions lengthwise of said impression, to move from side to side along said impression, and to pivot up and down with the contour of said impression.

7. A system according to claim 2 characterized in that said support means includes means for receiving the blank, and means for vacuum clamping the blank in place.

8. An impression unit for forming an impression of the undersurface of a person's foot to permit shaping of a custom-made insert in accordance with that impression, characterized in that said unit comprises an array of elements movable between lowered and raised positions, control means for yieldingly urging said elements toward their raised positions against the undersurface of the person's foot to form an impression in accordance with the contour of the undersurface of the person's foot, and locking means for thereafter locking said elements in place to retain said impression.

9. An impression unit according to claim 8 characterized in that said unit includes means forming guideways for said elements, said elements are disposed to move in said guideways, and said locking means is
5 operable for urging said elements laterally against said guideways to hold said elements in place.

10. An impression unit according to claim 9 characterized in that said array of elements is disposed
10 in columns and rows, said means forming guideways includes means forming first and second axially spaced aligned openings receiving said elements, and said locking means is selectively operable for urging said elements against edge portions of said openings to lock
15 said elements in positions conforming to the undersurface of the person's foot.

11. An impression unit according to claim 10 characterized in that said locking means includes inflatable
20 tubing disposed between adjacent pairs of columns for urging said elements laterally into holding engagement with the edge portions of said openings in response to inflation of said tubing.

25 12. An impression unit according to claim 8 characterized in that adjustable means is provided for registering the person's foot with respect to a portion of said array of elements.

30 13. An impression unit according to claim 8 characterized in that means is provided for impeding the raising of said elements at positions disposed forwardly of the locus for supporting the ball of the person's foot.

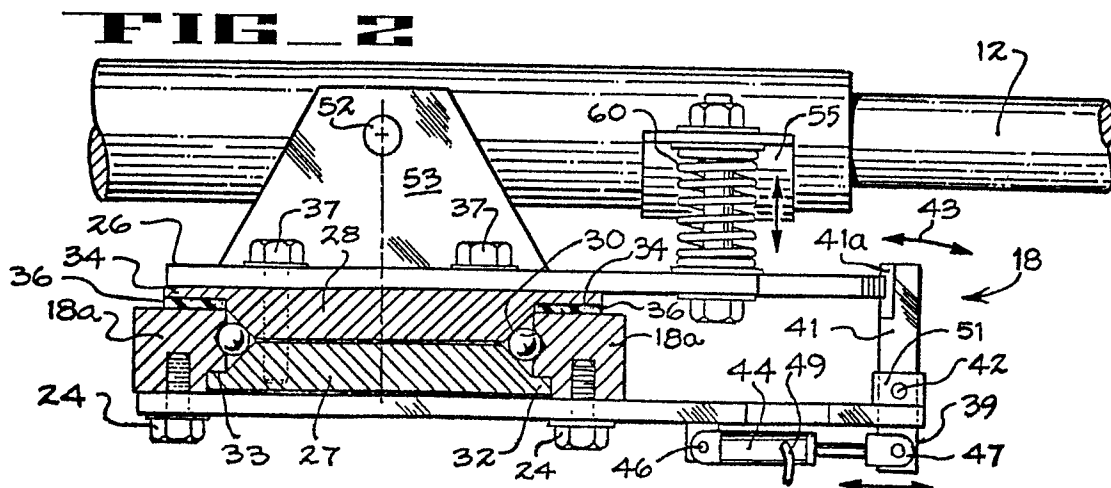
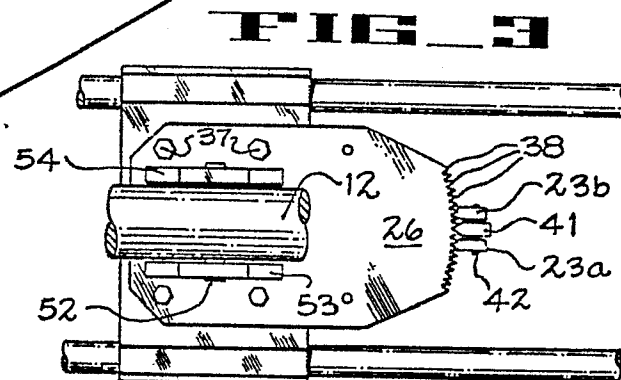
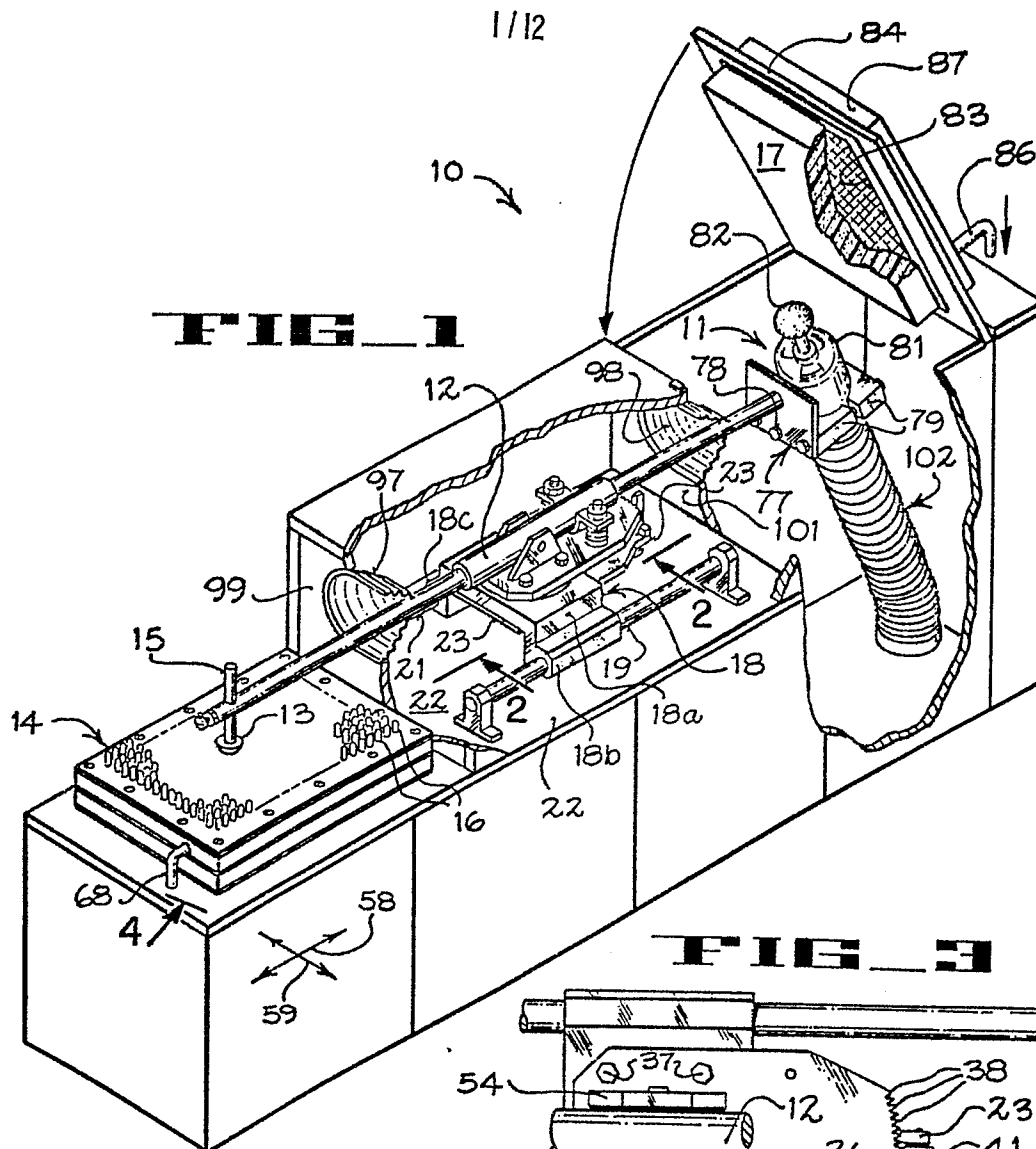
14. A blank for forming an insert adapted to be inserted into a shoe, said blank comprising a body of foam rubber generally formed to a predetermined shoe size, said body having a flat bottom surface from heel to toe thereof, a double-sided pressure-sensitive adhesive layer, one side of said adhesive layer being adhered to said flat bottom surface of said body, and a protective removable sheet applied to the other side of said adhesive layer.

10 15. A method of forming a custom-made insert for a given person's shoe wherein the contour of the support surface of the insert is shaped to substantially correspond to the negative image of the contour of the undersurface of the person's foot, said method comprising the steps
15 of making an impression of the contour of the undersurface of the person's foot, disposing a blank of material from which the insert is to be formed at a position proximate to said impression, and tracing the contour of the impression while shaping a corresponding negative image of that
20 contour in the blank.

25

30

35



2/12

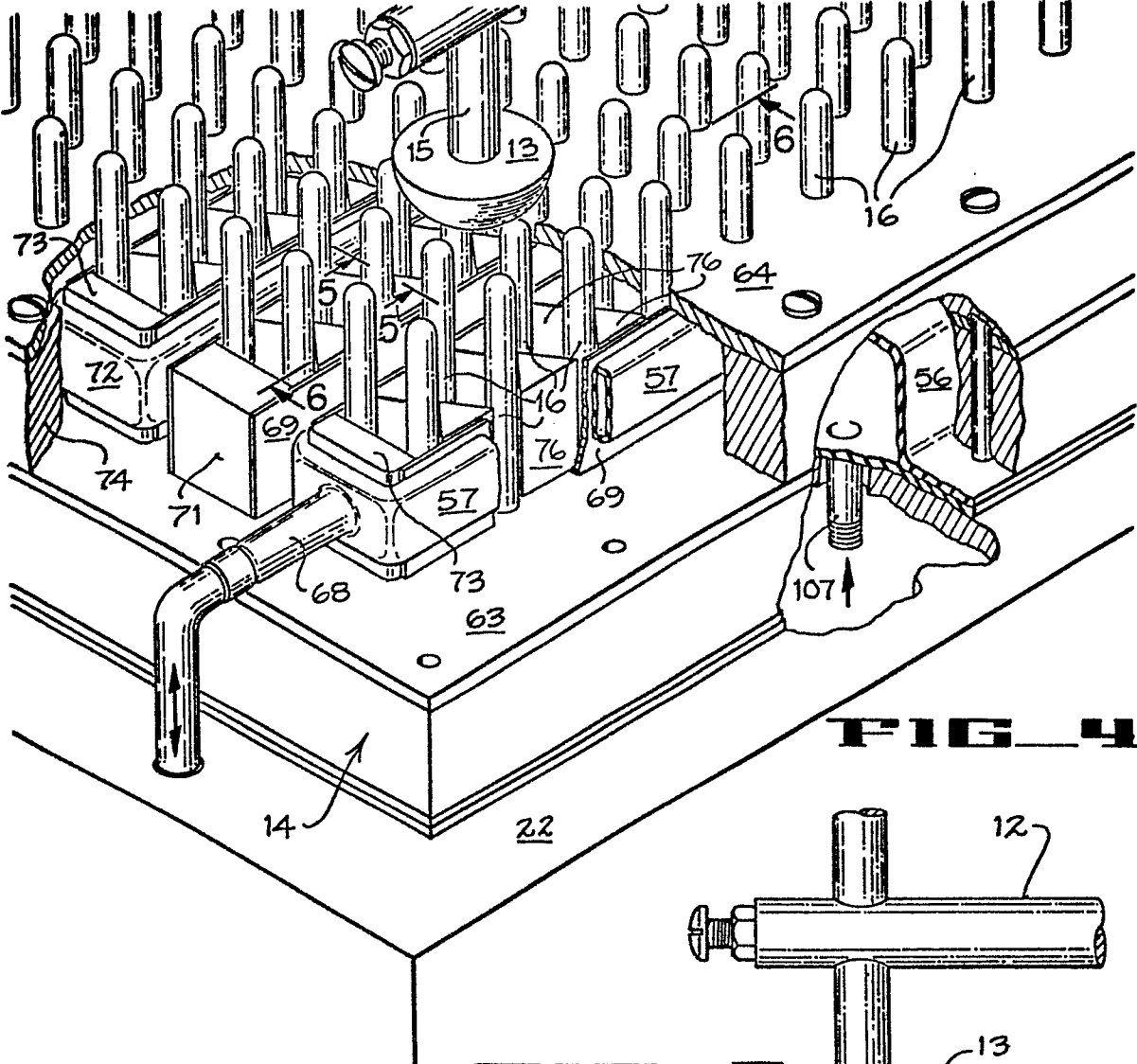


FIG. 4

FIG. 6

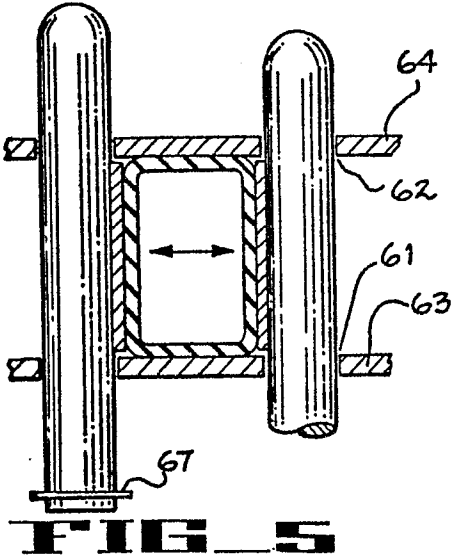
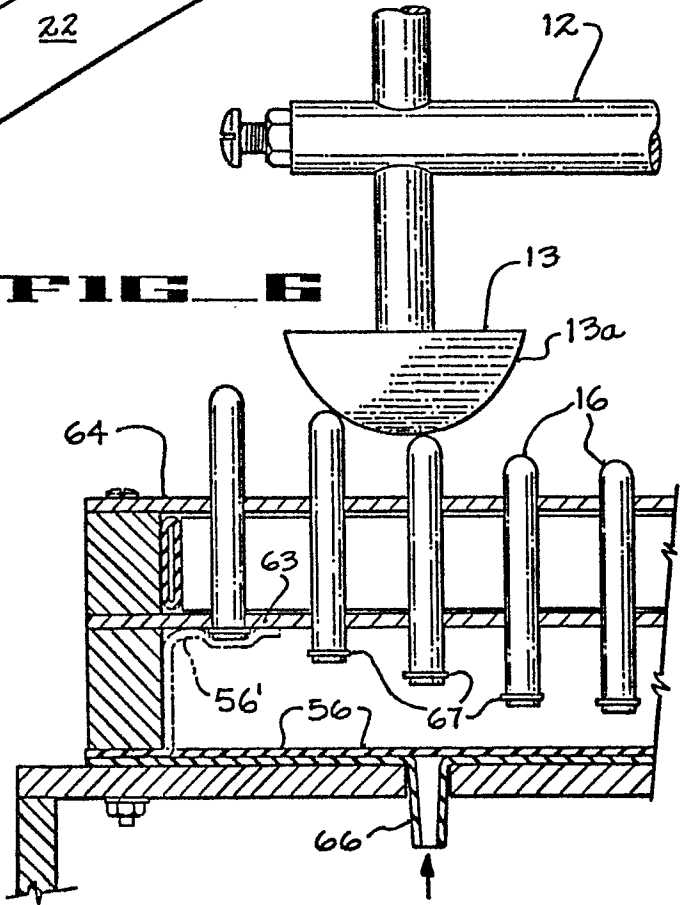
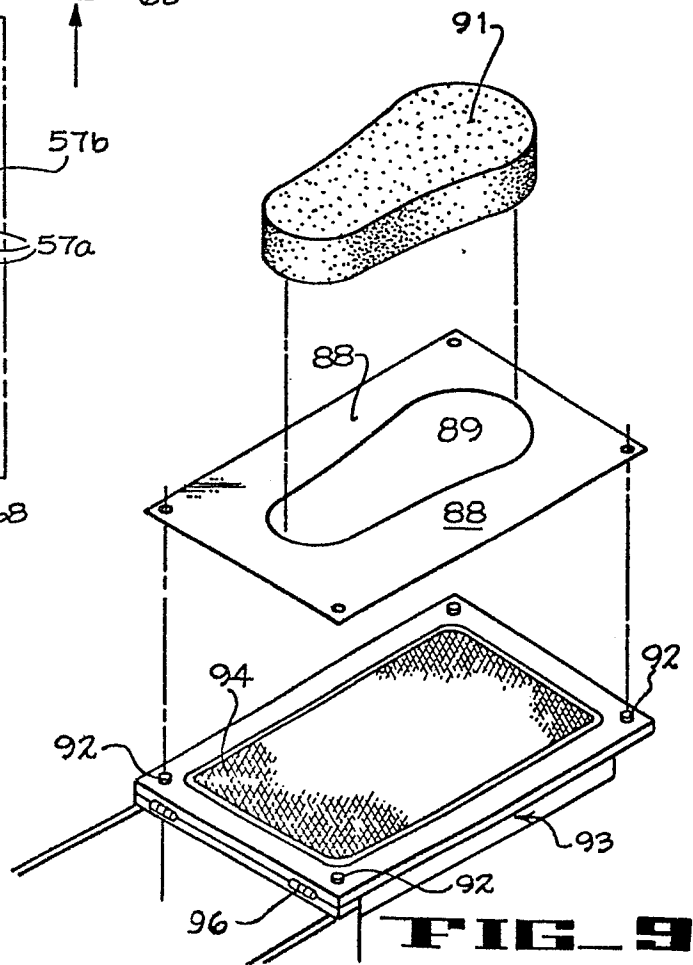
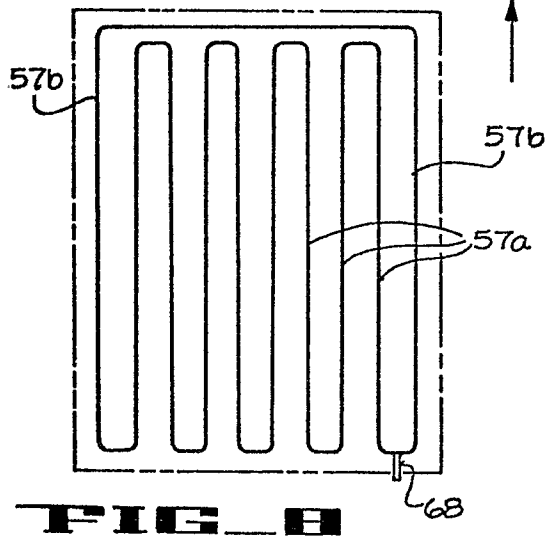
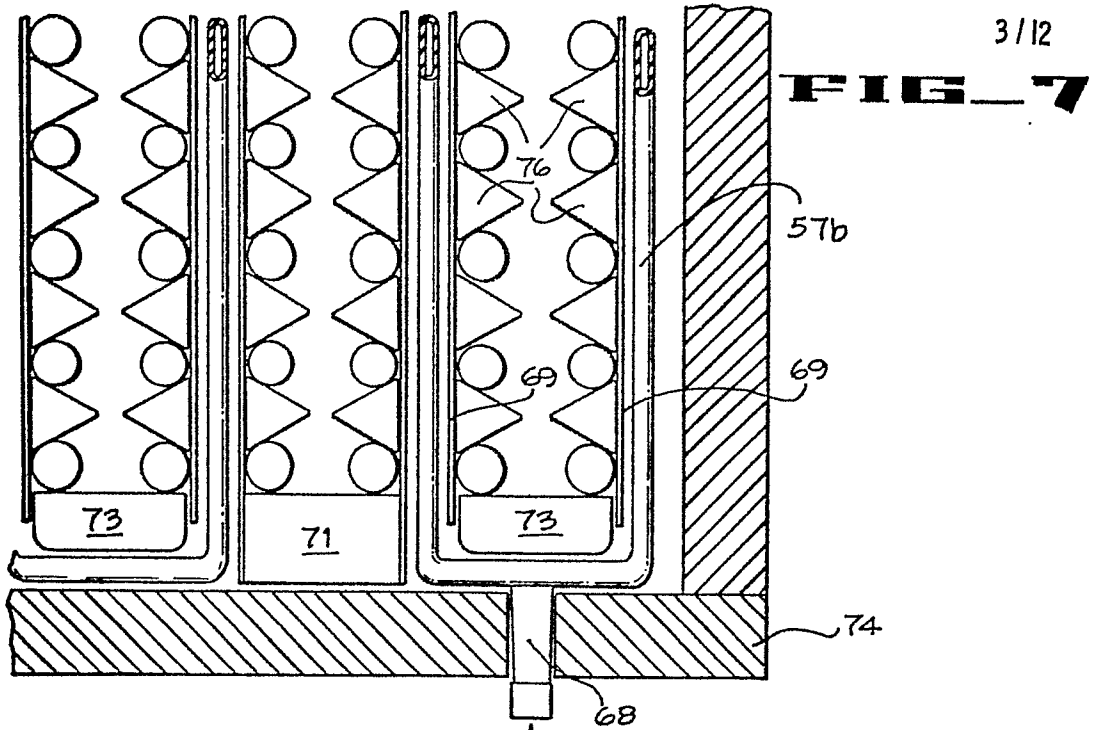
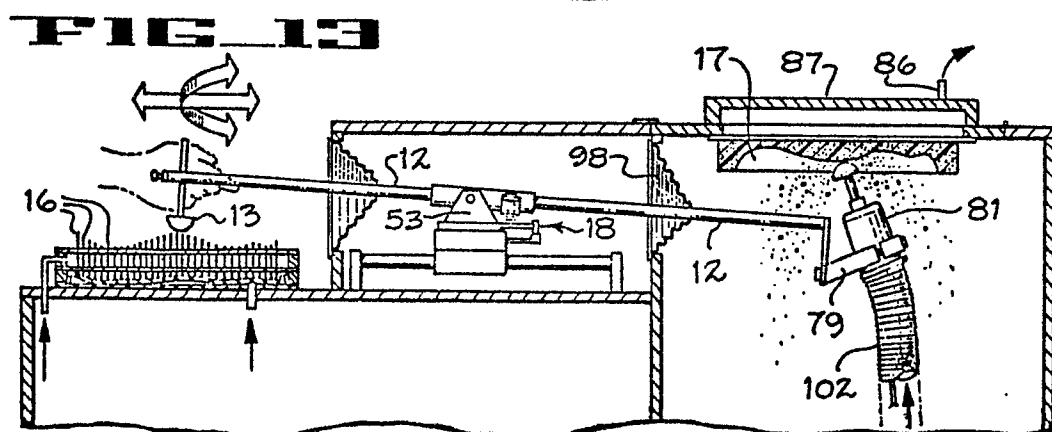
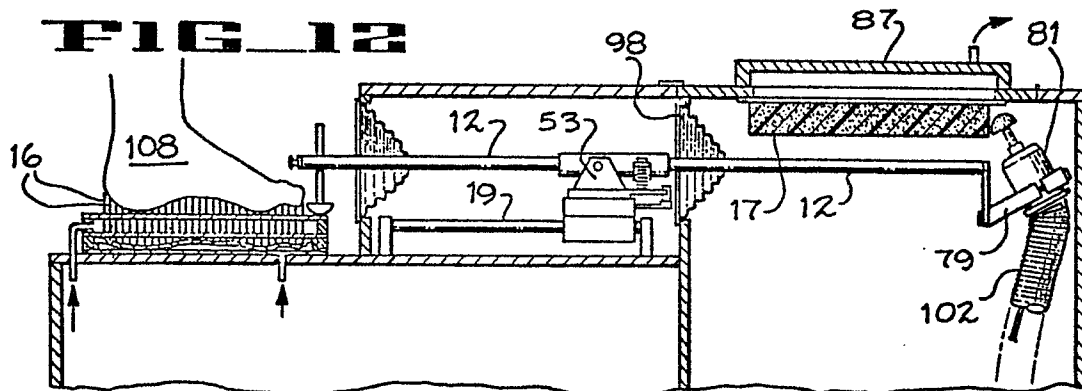
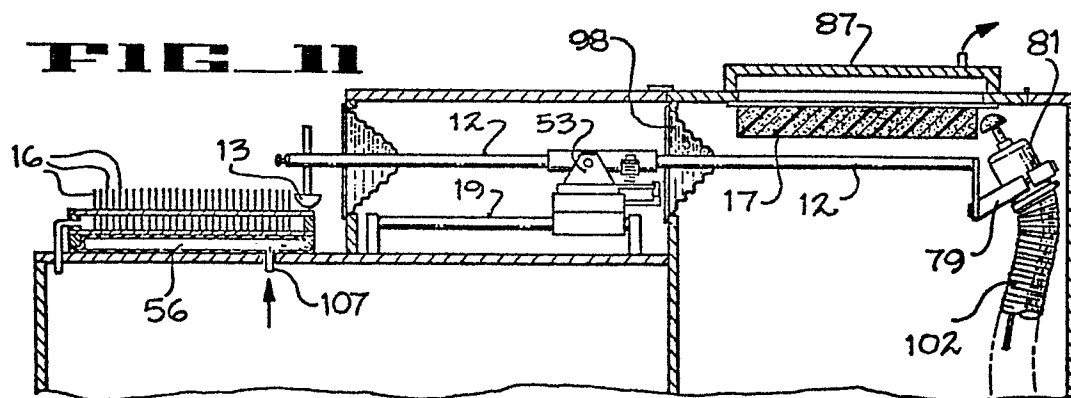
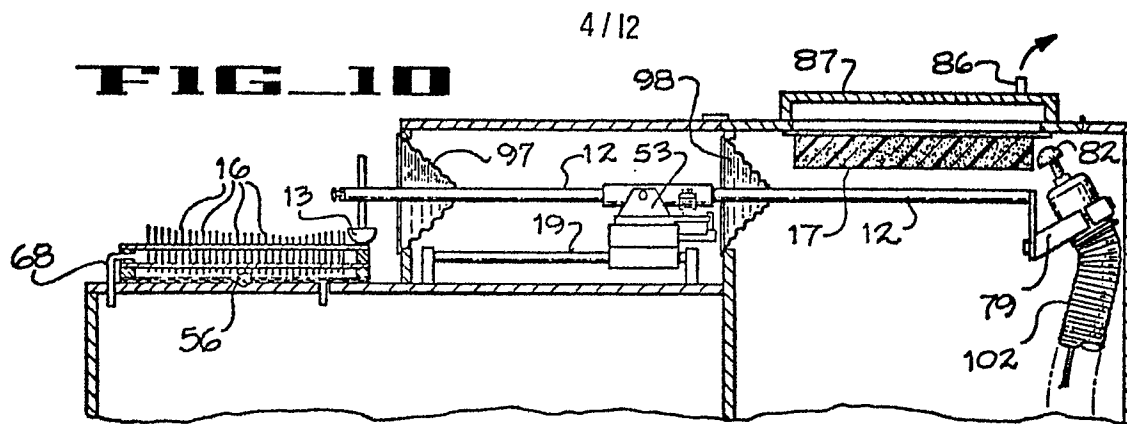


FIG. 5





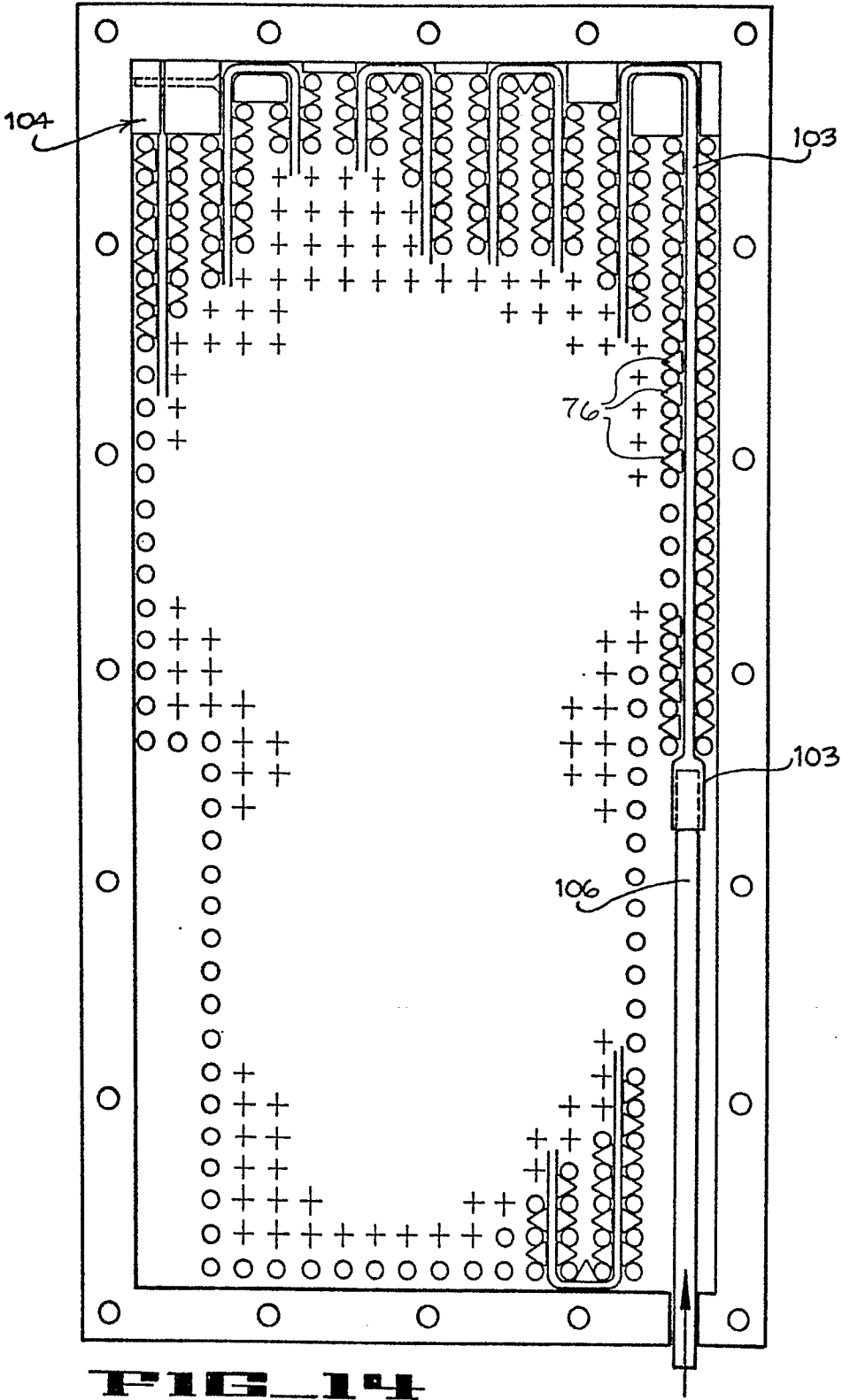


FIG. 15

6 / 12

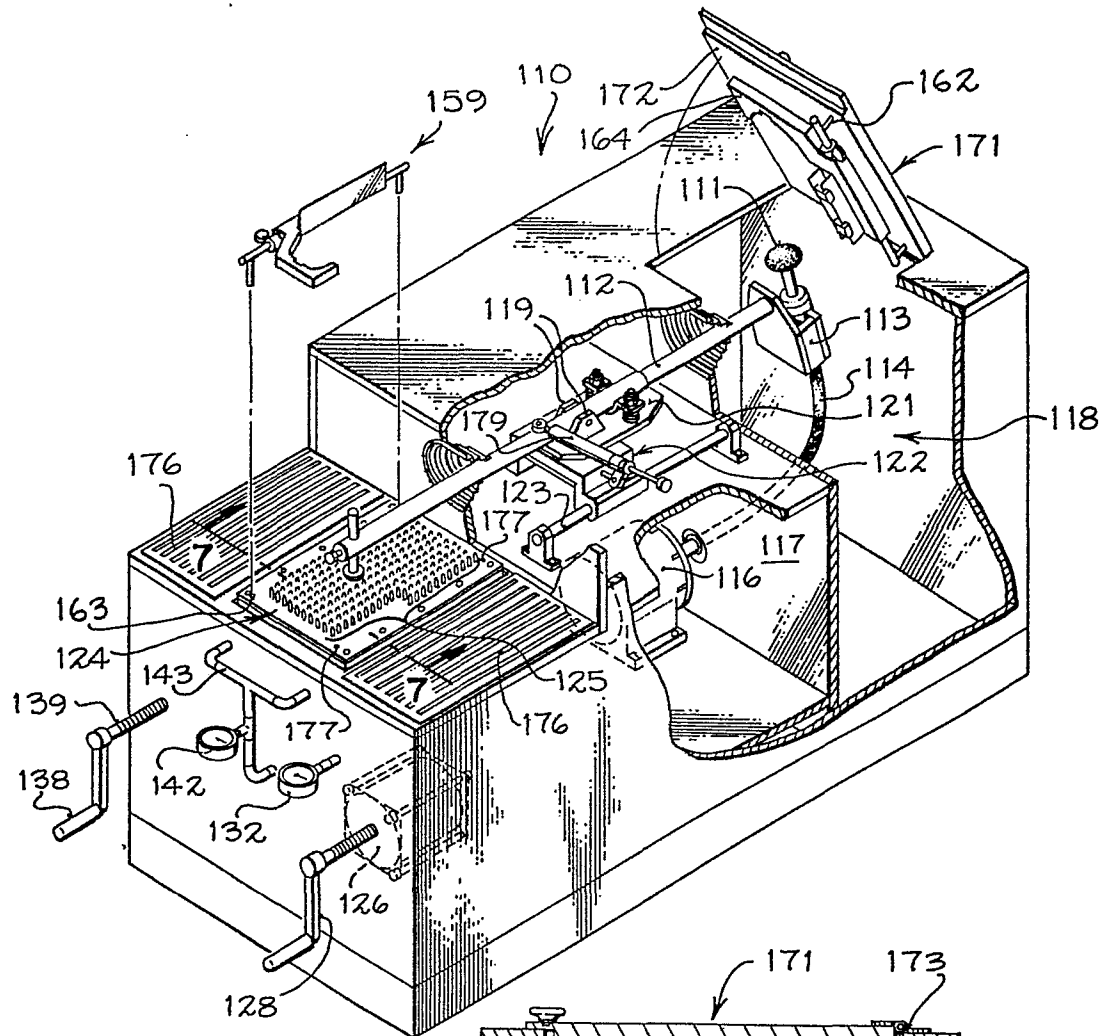
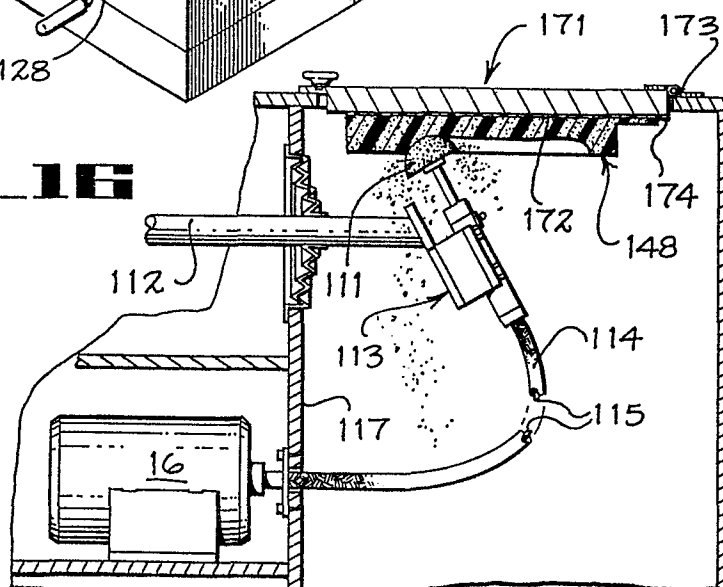


FIG. 16



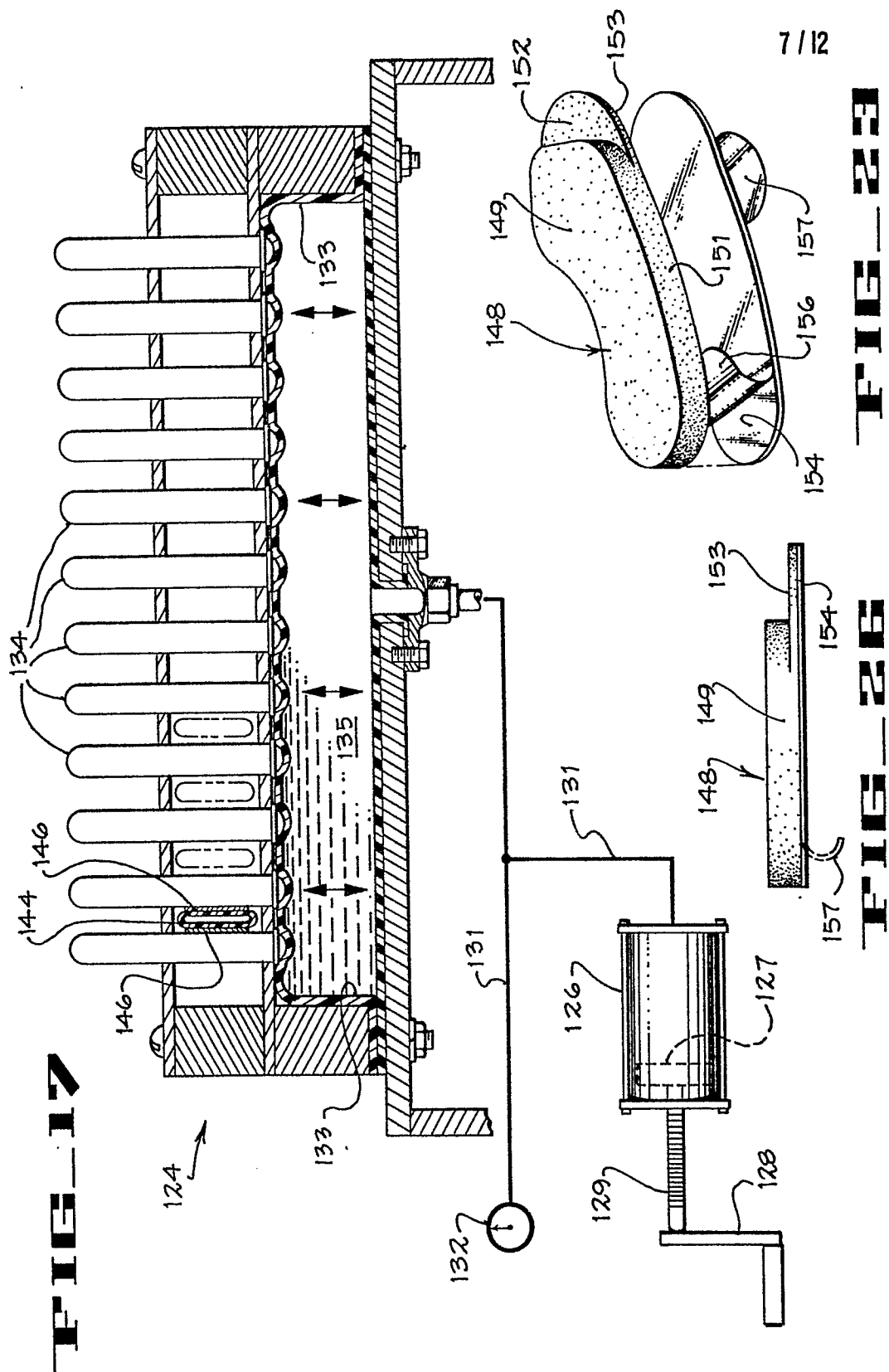
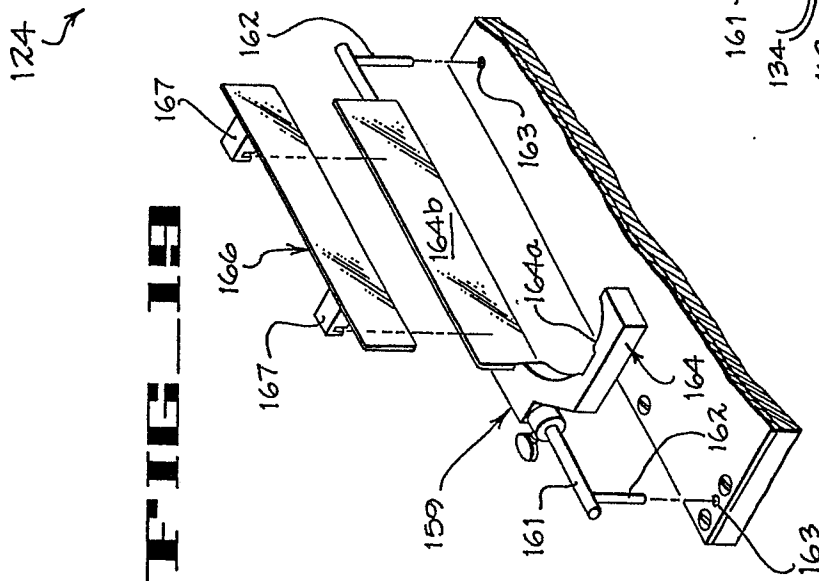
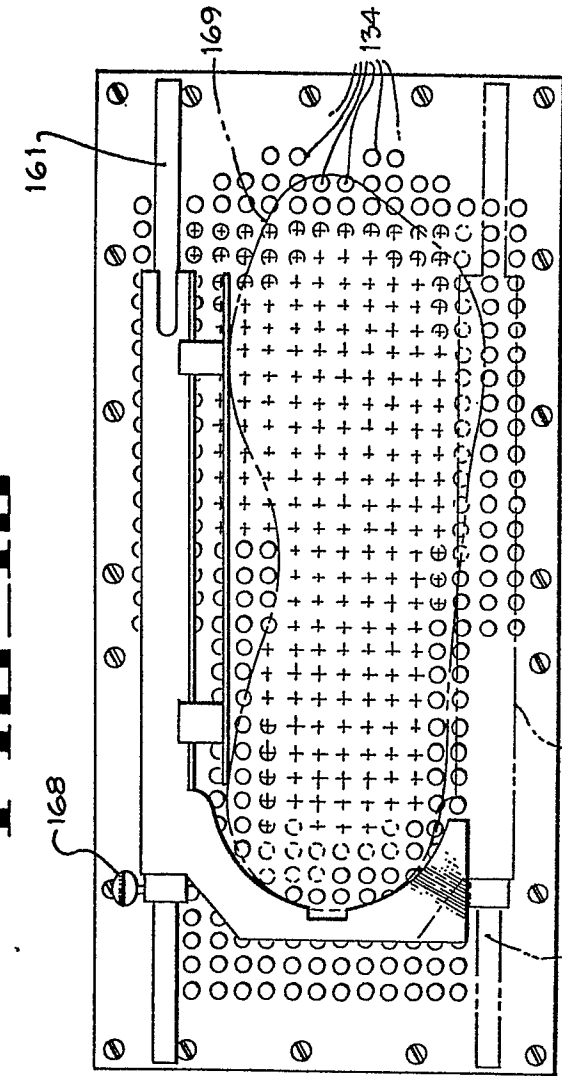


FIG. 18



8/12

FIG. 20

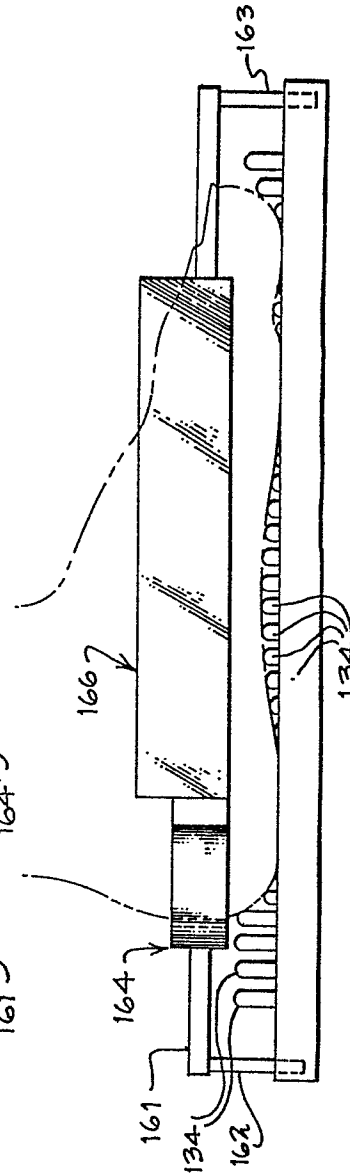


FIG. 21

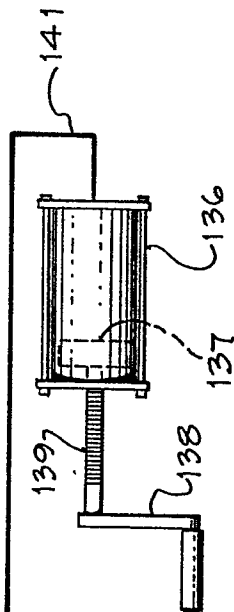
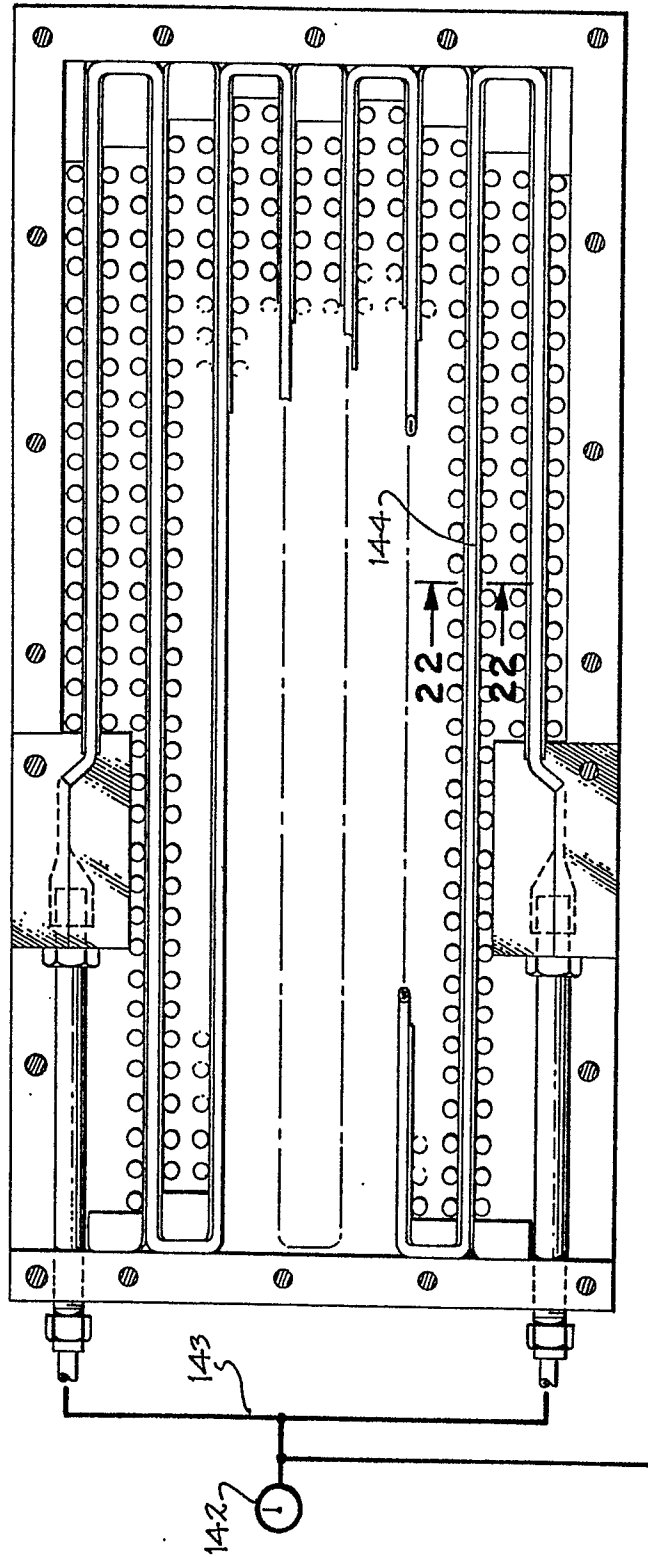
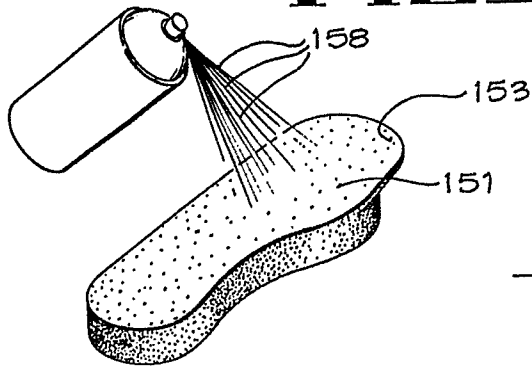


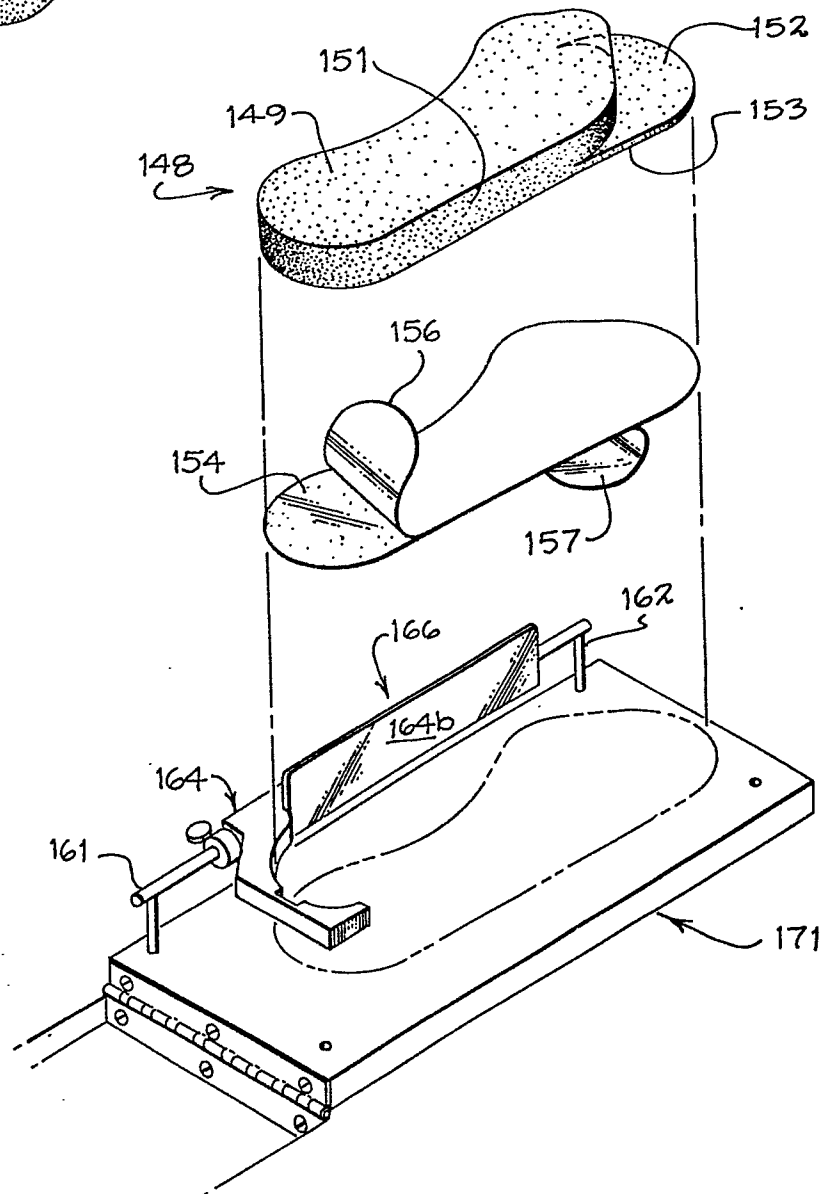
FIG. 22

FIG_24

10 / 12



FIG_25



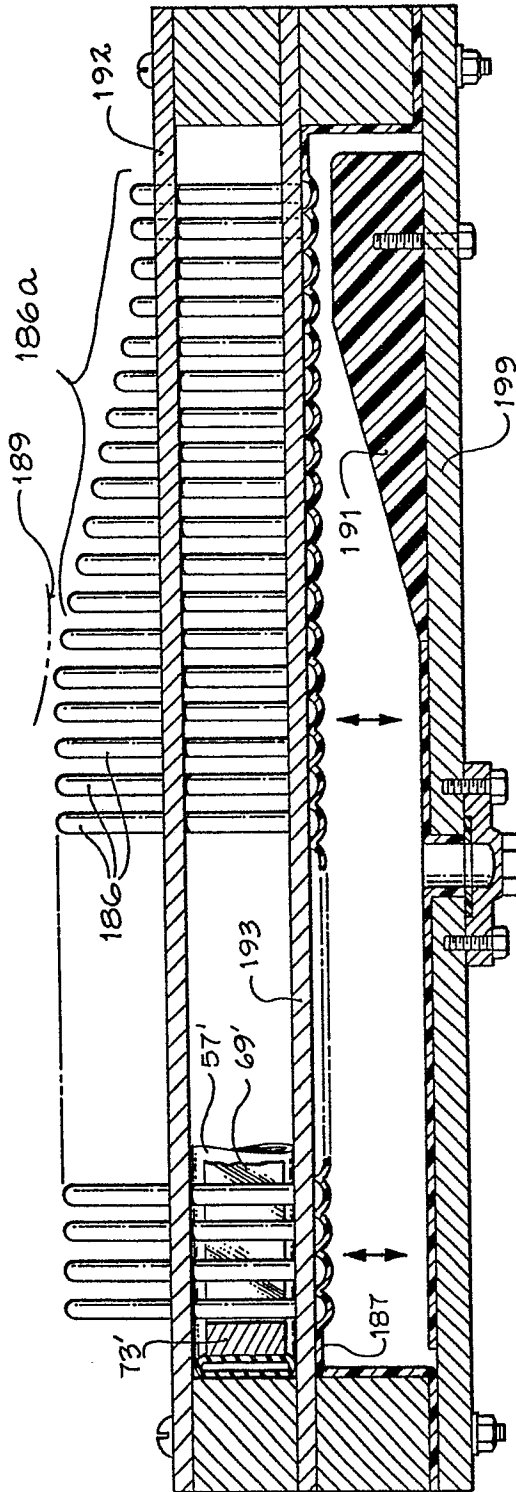


FIG. 27

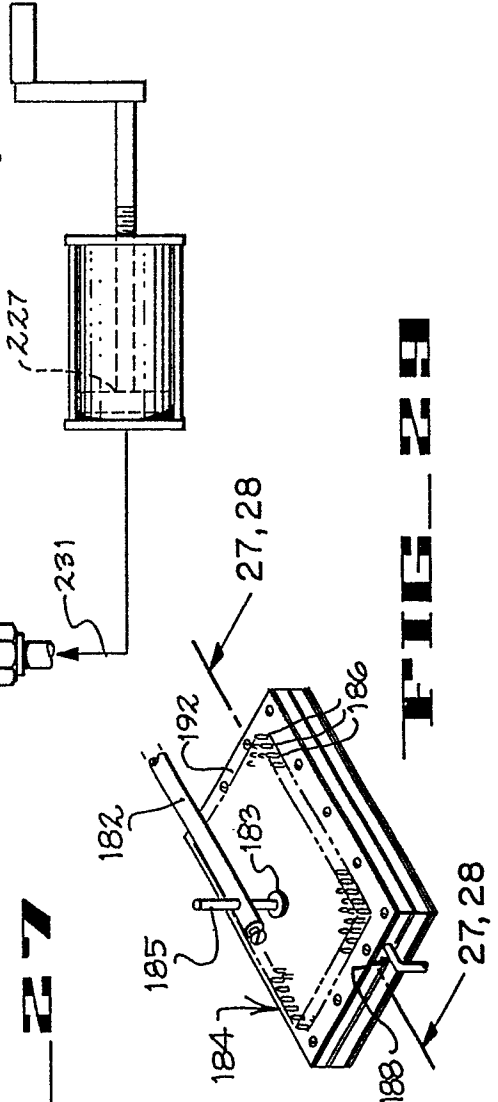
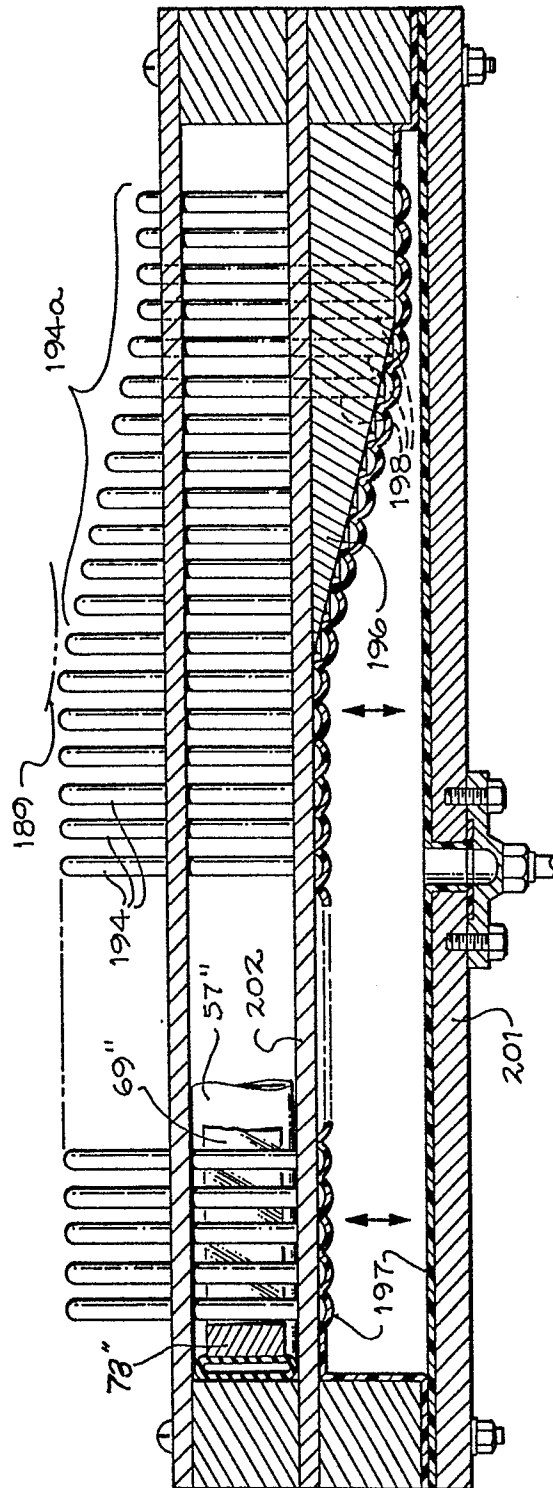


FIG. 28



NEIGH



European Patent
Office

EUROPEAN SEARCH REPORT

0086910

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 82 30 0866
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	<u>US - A - 2 230 143 (HYLAND)</u> * pages 4,5; figures 1,4 * --	1-4,6, 8,15	A 43 D 1/00 39/00
X	<u>US - A - 2 323 538 (HYLAND)</u> * figures 2,7 * --	1-4,6, 8,12, 15	
X	<u>FR - A - 761 626 (GIUNTINI)</u> * page 2, left-hand column * --	8-10	
X	<u>FR - A - 759 013 (MATTHIAS)</u> * figure 1 * -----	8-10	TECHNICAL FIELDS SEARCHED (Int. Cl. ³) A 43 D 1/00
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 18-02-1983	Examiner LOKERE
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claims:
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

X LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,

namely:

1. claims 1-13,15: System, apparatus, method
2. claim 14: Blank (claimed independently)

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims.

namely claims: 1-13,15