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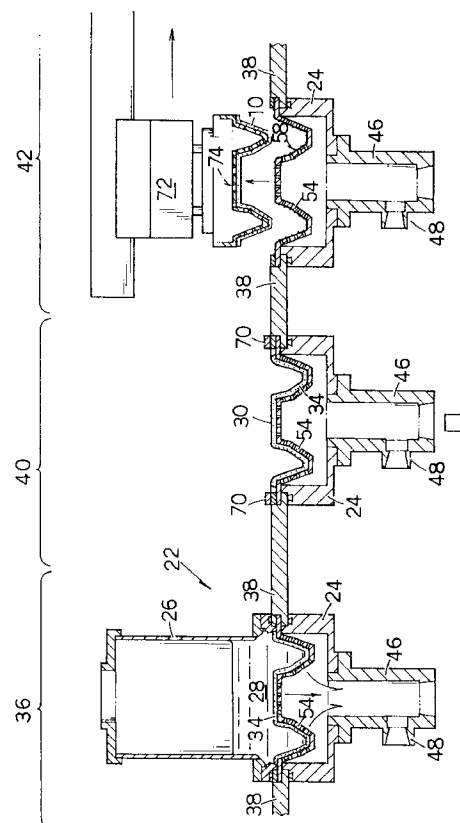
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(54) **Formed sheet product and sheet forming.**

(57) A product ingredient (34) is deposited on a carrier net (58) from a liquid stock solution (28). The deposited product ingredient is subject to surface finishing using a sheet-like presser (30) which is pressed against the surface of the product ingredient away from the carrier net so that said surface may be provided with a desired surface finish.

FIG. 4



This invention relates to a sheet-like product manufactured by sheet forming (hereinafter referred to as "formed sheet product" or merely "sheet product") and sheet forming, and more particularly but not exclusively to a formed sheet product mainly made of a pulp material and suitably used as a cushioning support, a container or the like, and a method and an apparatus for manufacturing such a formed sheet product while providing the product with desired surface finishing.

In order to safely pack a household appliance, a precision mechanical equipment, a fragile article or the like, a cushioning support material is widely used in combination with a packing material to protect it from damage. For this purpose, a cushioning material which is formed of expanded polystyrene, a pulp material or the like into a predetermined configuration is extensively used.

Conventionally, such a cushioning material is manufactured by various methods including sheet forming and the like. Conventional sheet forming generally permits one surface of a product to be relatively smoothly finished because it is supported on a carrier net during the sheet forming. However, the other surface of the product is finished into unevenness because it is not regulated during the sheet forming, so that the product is highly deteriorated in quality. More particularly, as shown in Fig. 1, a formed sheet product manufactured according to the conventional sheet forming, which is generally indicated at reference numeral 100, causes an upper surface of a body 102 of the product to be formed with lots of unevenness 104 as shown in Fig. 1. The words "lower surface" of a formed sheet product or its body used herein indicate a surface of the product supported on a carrier net and the words "upper surface" thereof indicate a surface thereof opposite thereto.

Thus, in the conventional sheet forming, it is required to subject the upper surface of the product to smooth finishing or the like. For example, it is required to repeatedly subject the upper surface of a web-like product ingredient deposited on the carrier net during sheet forming to pressing using a pressing head. Unfortunately, this causes the deposited web-like product ingredient to be rendered non-uniform in thickness and/or damaged. In order to avoid the problem, it would be considered that the pressing is carried out after drying of the product ingredient. However, this fails to provide the other surface of the product ingredient with satisfactorily smoothness because the drying provides the product ingredient with shape-retention, resulting in failing to provide the product with high density. Thus, the conventional sheet forming fails to enhance the productivity and reduce the manufacturing cost.

The present invention has been made in view of the foregoing disadvantage of the prior art.

In accordance with one aspect one the present in-

vention, a surface-finished formed sheet product which is formed by subjecting a product ingredient of a liquid feedstock to sheet forming is provided, wherein one surface of the formed sheet product is supported on a carrier net of a predetermined shape during the sheet forming, and the other surface of the formed sheet product is pressed by a presser means during the sheet forming.

In accordance with another aspect of the present invention, there is provided a method for manufacturing a surface-finished formed sheet comprising the steps of feeding a carrier net with a liquid feedstock consisting of a liquid ingredient and a product ingredient to downward flow only the liquid ingredient of the liquid feedstock through the carrier net, to thereby deposit the product ingredient on the carrier net, the carrier net being formed so as to regulate an outer configuration of the formed sheet product; and pressing a surface of the deposited product ingredient opposite to the carrier net by a presser means while keeping the product ingredient deposited on the carrier net, to thereby subject the product ingredient to surface finishing.

In a preferred embodiment of the present invention, pressing of the product ingredient deposited on the carrier net by the presser means is carried out by vacuum suction on aside of the carrier net.

In accordance with a further aspect of the present invention, an apparatus for manufacturing a formed sheet product is provided. The apparatus comprises a forming cup adapted to be downward evacuated to vacuum, a carrier net arranged in the forming cup and adapted to permit a product ingredient of a liquid feedstock to be deposited thereon, and a presser means adapted to be put on the product ingredient deposited on the carrier net. Pressure applying means press the presser means downwardly against the product ingredient on the carrier net.

Some preferred embodiments of the invention will now be described, by way of example and with reference to the accompanying drawings in which:

Fig. 1 is a perspective view showing a conventional formed sheet product;

Fig. 2 is a perspective view showing a formed sheet product according to the present invention and a magnet for driving a speaker which is to be protected by the formed sheet product;

Fig. 3 is a perspective view of the formed sheet product shown in Fig. 2 which is inverted;

Fig. 4 is a schematic view showing a series of steps in manufacturing of a formed sheet product of the present invention;

Fig. 5 is a vertical sectional view showing a step of feeding support liquid;

Fig. 6 is a vertical sectional view showing flowing-down of a liquid ingredient of a liquid feedstock fed;

Fig. 7 is a vertical sectional view showing a prod-

uct ingredient for a formed sheet product which is deposited on a carrier net;

Fig. 8 is a vertical sectional view showing a formed sheet product during surface finishing; and

Fig. 9 is a vertical sectional view showing another embodiment of sheet forming according to the present invention.

Now, the present invention will be described hereinafter with reference to Figs. 2 to 9.

Referring first to Figs. 2 and 3, an embodiment of a formed sheet product according to the present invention which has been subject to surface finishing is illustrated. A formed sheet product of the illustrated embodiment which is generally designated by reference numeral 10 is in the form of a cushioning support used for packing a member 12 such as a speaker driving magnet or the like. More particularly, the formed sheet product 10 includes a body 14 which is generally formed into a concave shape in vertical section. Thus, the body 14 has a recess section 16 formed at a central portion thereof, a flange section 18 formed in a manner to outward extend from an upper end of the recess section 16, and a skirt-like peripheral section 20 formed so as to downward extend by a distance or height substantially equal to a depth of the recess section 16 from an outer end of the flange section 18, to thereby surround the recess section 16. In the illustrated embodiment, as will be noted from the above definition, a surface of the formed sheet product 10 which is viewed as an obverse surface in fig. 2 is supported on a carrier net as described hereinafter and thus defined to be a lower surface and a reverse surface opposite thereto is defined to be an upper surface. The upper surface of formed sheet product 10 is subject to pressing by a sheet-like presser during sheet forming, to thereby be smoothly finished as shown in Fig. 3, as will be detailedly described hereinafter.

The illustrated embodiment which is directed to a formed sheet product is in the form of a cushioning support which is generally formed into a concave shape in vertical section. However, the present invention is not limited to such a form. For example, the formed sheet product of the present invention may take the form of a complicated configuration such as a cover paper for a blister package, a shape of container such as a cup or a tray, or the like.

Now, manufacturing of the formed sheet product of the illustrated embodiment constructed as described above will be described hereinafter with reference to Figs. 4 to 8. A sheet forming apparatus which is used for practicing the manufacturing is generally designated at reference numeral 22 and includes a forming cup 24, which is adapted to be combined with a liquid feed cup 16 for feeding a liquid feedstock 28 to the forming cup 24. Then, the forming cup 24 is combined with a sheet-like presser 30 after a liquid in-

gredient is removed from the liquid feedstock to provide a non-liquid ingredient or product ingredient 34 for the formed sheet product, so that an upper surface of the product may be subject to finishing.

Now, a combination between the forming cup 24 and the liquid feed cup 26 will be described. The combination is carried out in a liquid feed zone 36. The forming cup 14 may be supported on a suitable frame. However, in the illustrated embodiment, it may be supported on a turntable 38, which may be turned in turn to move the forming cup 24 from the liquid feed zone 36 to a finishing zone 40 at which the sheet-like presser 30 is applied to the product ingredient 34 and then to an unloading zone 42. Alternatively, the forming cup 24 may be moved by any suitable transversing means.

The forming cup 24, as detailedly shown in Fig. 5, is formed into a vessel-like configuration having a liquid removing chamber 44 defined therein. The forming cup 24 is provided at a bottom thereof with a liquid discharge pipe 46, which is arranged so as to communicate with the liquid removing chamber 44 and extend downwardly therefrom. To the liquid discharge pipe 46 is connected a support liquid feed pipe 48. The liquid discharge pipe 46 is provided with a valve 50 (Fig. 6) which functions to carry out switching between flowing-down of liquid by gravity through the pipe 46 and forcible flowing-down of liquid by vacuum suction as required. Likewise, the support liquid feed pipe 48 is provided with a valve 52, which acts to control feeding of support liquid.

On the forming cup 24 is mounted a supporter 54 supported on a supporter holding portion 56 of the cup 24. The supporter 54 is formed into a configuration corresponding to the formed sheet product 10 so as to act as a so-called mold. On the supporter 54 is supported a carrier net 58 in a manner to be intimately fitted thereon. the supporter 54 is formed with a plurality of perforations 60 through which liquid is extracted.

The forming cup 24 thus constructed is then combined with or connected to the liquid feed cup 26 in the liquid feed zone 36. The liquid feed cup 26 is constructed in the form of a cylindrical vessel of which a lower end is open and an inner space acts as a liquid feed chamber 62. The liquid feed cup 26 is provided at an upper end thereof with a liquid feed port 64. Also, the liquid feed cup 26 is provided at a lower end thereof with a flange 66, which is provided with a seal ring 68.

Subsequently, the forming cup 24 is then combined with the sheet-like presser 30. The sheet-like presser 30 may comprise a highly extensible sheet material such as a rubber sheet or the like stretchedly mounted on a holding ring 70. A single rubber sheet may be used for the presser 30. Alternatively, a combination of the rubber sheet and a highly extensible woven fabric like a knitted fabric may be used. The

sheet-like presser 30 may be formed into a smooth surface. This causes the upper surface of the formed sheet product to be smoothed. Alternatively, a woven fabric may be exposed on the sheet-like presser 30. This causes both surfaces of the formed sheet product to be patterned because a mesh-like pattern of the carrier net 58 may be transferred to the lower surface of the formed sheet product. Further, a surface of the rubber sheet of the sheet-like presser 30 may be formed with any desired pattern to positively provide the upper surface of the formed sheet product with a desired pattern.

For manufacturing of the formed sheet product, the liquid feed cup 26 and sheet-like presser 30 are adapted to stand by at the liquid feed zone 36 and finishing zone 40 in the sheet forming apparatus 22, respectively, and the forming cup 24 is moved to the liquid feed cup 26 and presser 30 in turn with turning of the turntable 38. Alternatively, any other means or mechanism may be suitably used for relative movement between the forming cup 24 and the liquid feed cup 26 and presser 30 so long as desired liquid feed operation and finishing operation may be accomplished.

At the unloading zone 42, the formed sheet product which is a semi-finished article formed into a sheet-like shape on the carrier net 58 and subjected to surface finishing is unloaded or removed from the forming cup 24. To this end, an unloading head 72 provided with a suction port 74 is downwardly moved to the formed sheet product 10, so that the product is held on the unloading head 72 by suction while, as required, upwardly feeding air to the product 10 from below to float the product. This may be carried out using any suitable conventional procedure known in the art.

Now, a procedure for manufacturing the formed sheet product 10 using the sheet forming apparatus 22 constructed as described above will be described hereinafter.

First, feeding of the support liquid to the liquid removing chamber 44 is carried out. For this purpose, the liquid feed cup 26 is positioned above the forming cup 24 and lowered onto the cup 24, to thereby be intimately connected to the forming cup 24. Then, the valve 52 is opened to feed support liquid 76 from the support liquid feed pipe 48 into the forming cup 24 to fill the liquid removing chamber 44 with the liquid 76. This effectively prevents the liquid feedstock 28 from flowing down from the forming cup 24 through the supporter 54 into the liquid removing chamber 44 immediately when the liquid feedstock 28 is fed to the forming cup 24.

After the liquid removing chamber 44 is filled with the support liquid 76, the liquid feedstock 28 which contains a liquid ingredient and a product ingredient is fed in a predetermined quantity from the liquid feed port 64 of the liquid feed cup 26 into the liquid feed chamber 62. Then, the valve 50 of the liquid discharge

pipe 46 is suitably operated to permit the support liquid 76 and liquid feedstock 28 to flow down together. The flowing-down of liquid may be naturally carried out by gravity or forcibly carried out by suction. Alternatively, a combination thereof may be used for this purpose. For example, the combination may be carried out in such a manner that the flowing-down by gravity initially takes place for a predetermined period of time and then the flowing-down by suction takes place. This causes the liquid ingredient 32 of the liquid feedstock 28 to flow down, resulting in the non-liquid ingredient or product ingredient 34 being deposited on the carrier net 58. The product ingredient 34, when the formed sheet product to be obtained is a paper product, may mainly consist of a component such as pulp, cellulose or the like, as well as any suitable functioning material such as resin and the like which may provide the product with any desired mechanism properties.

When the product ingredient 34 is thus deposited in the form of a sheet like shape on the carrier net 58, the turntable 38 is turned to move the forming cup 24 from the liquid feed zone 36 to the finishing zone 40. It is a matter of course that prior to turning of turntable 38, the liquid feed cup 26 is retracted upwardly. When the forming cup 24 is thus moved to the finishing zone 40 in which the presser 30 is arranged and the presser 30 is placed on the deposited sheet-like product ingredient 34 as shown in Fig. 7, the valve 50 of the liquid discharge pipe 46 is operated to promote vacuum suction in the liquid removing chamber 44. This causes the presser 30 to be forcibly deformed and conform to the product ingredient 34, resulting in the ingredient 34 being pressed downwardly, as shown in Fig. 8. The product ingredient 34 is kept pressed for a predetermined length of time and then the ingredient 34 is released from the vacuum suction, so that the ingredient 34 may be provided with a fully smoothly finished upper surface.

After the product ingredient 34 is thus finished, the forming cup 24 is transferred from the finishing zone 40 to the unloading zone 42, in which the product ingredient 34 is subject to suction through the unloading head 72, to thereby be removed upwardly from the forming cup 24 as shown in Fig. 4, resulting in the formed sheet product 10. When the formed sheet product is complicated in configuration, it may be removed together with the carrier net 58 and, if required, the supporter 54 from the forming cup 24.

In the illustrated embodiment, the forming cup 24 is transferred together with the carrier net 58 from the liquid feed zone 36 through the finishing zone 40 to the unloading zone 42 while being accompanied by the supporter 54. Alternatively, the embodiment may be so constructed that a combination of the supporter 54 and carrier net 58 is mounted on the turntable 38 and the forming cup 24 is arranged so as to be vertically moved only in the liquid feed zone 36. In this in-

stance, a member for suction is applied to the lower side of the product ingredient 34 in the finishing zone 40.

Also, in the illustrated embodiment, the sheet-like presser 30 is pressed against the product ingredient 34 on the carrier net 58 by suction from below. Alternatively, a pressure may be applied downwardly to the presser 30 to press it against the ingredient 34. For example, a pneumatic pressure, a hydraulic pressure or the like may be applied downwardly to the sheet-like presser 30. Alternatively, a number of pin-like pressing members may be arranged so as to act on the ingredient 34.

Referring now to Fig. 9, another embodiment of the present invention is illustrated, in which surface finishing of a sheet-like product ingredient is carried out in the same zone as deposition of the product ingredient on a carrier net. More particularly, a forming cup 24 is arranged in a liquid feedstock tank 78 so as to be vertically moved through a cylinder 80. Correspondingly, a finishing head 82 is arranged right above the forming cup 24 so as to be vertically moved through a cylinder 84. A sheet-like presser 30 is mounted on a lower surface of the finishing head 82.

In the embodiment of Fig. 9 thus constructed, a liquid feedstock 28 is charged in the forming cup 24 to a level sufficient to permit the forming cup 24 to be fully immersed in the liquid feedstock 28. Then, a rod 86 of the cylinder 80 is extended to raise the forming cup 24 to an upper surface of the liquid feedstock 28, to thereby charge the forming cup with the liquid feedstock 28. Thus, the forming cup 11 is considered to be integral with the liquid feed cup 26 in the above-described embodiment, resulting in being provided with a volume which permits a sufficient amount of the liquid feedstock to be received therein. Thus, in the illustrated embodiment, it is considered that a carrier net 58 is arranged in proximity to a bottom of the forming cup 24. The remaining part of the embodiment shown in Fig. 9 may be constructed in substantially the same manner as the embodiment described above.

In the embodiment shown in Fig. 9, after the liquid feedstock 28 is received in the forming cup 24, a liquid ingredient of the feedstock 28 is immediately discharged through a liquid discharge pipe to cause a product ingredient to be deposited on the carrier net 58. Then, the cylinder 84 is actuated to lower the finishing head 82 to cause the sheet-like presser 30 to be inserted into the forming cup 24 maintained at a top dead center thereof and concurrently vacuum suction is carried out to press the sheet-like presser 30 against an upper surface of the product gradient. Then, an unloading head 72 is traversed to the product ingredient which has been subject to surface finishing, resulting in being a semi-finished product. This causes the product ingredient to be transferred to a dehydration or dry position.

As can be seen from the foregoing, the present invention permits both surfaces of the formed sheet product to be smoothed and, if required, patterned. Thus, the formed sheet product is directed to a variety of applications. Also, the present invention permits the product ingredient deposited in a sheet-like form on the carrier net to be pressed against the presser to smooth the upper surface of the product ingredient, resulting in subsequent pressing and drying steps being minimized. Thus, pressing and drying apparatus can be small-sized, leading to a decrease in manufacturing cost of the formed sheet product. Also, pressing of the product ingredient against the presser is carried out immediately after deposition of the ingredient on the carrier net, so that the product ingredient may be compressed into high density sufficient to exhibit increased mechanical strength.

From the foregoing description, it will also be seen that in its preferred forms at least, the present invention provides a formed sheet product which is capable of exhibiting satisfactory quality;

a formed sheet product of which a whole surface is capable of substantially improving the productivity and reducing the manufacturing cost;

a method and apparatus for manufacturing a formed sheet product which is capable of manufacturing a formed sheet product with satisfactory quality; and

a method and apparatus for manufacturing a formed sheet product which is capable of providing a formed sheet product at a low manufacturing cost and with improved productivity; and

a method and apparatus for manufacturing a formed sheet product which is capable of accomplishing satisfactory surface finishing on a formed sheet product at a stroke.

Claims

1. A surface-finished formed sheet product (10) which is formed by subjecting a product ingredient of a liquid feedstock (28) to sheet forming, characterised in that:

one surface of said formed sheet product is supported on a carrier net (58) of a predetermined shape during the sheet forming; and

the other surface of said formed sheet product is pressed by a presser means (30) during the sheet forming.

2. A surface-finished formed sheet product as defined in claim 1, characterised in that at least one of said surfaces of said formed sheet product (10) is smoothly finished.

3. A surface-finished formed sheet product as defined in claim 1 or 2, characterised in that at least

one of said surfaces of said formed sheet product (10) is patterned.

4. A surface-finished formed sheet product as defined in any preceding claim, characterised in that said presser means (30) comprises a sheet-like presser of increased extensibility. 5
5. A method of manufacturing a surface-finished formed sheet product (10), characterising in that the method comprises the steps of: 10
 - feeding a carrier net (58) with a liquid feedstock (28) consisting of a liquid ingredient (32) and a product ingredient (34), so that the liquid ingredient of the liquid feedstock flows downwardly through the carrier net, to thereby deposit the product ingredient on the carrier net, said carrier net being formed so as to regulate an outer configuration of the formed sheet product; and 15
 - pressing a surface of the deposited product ingredient opposite to the carrier net by a presser means (30) while keeping the product ingredient deposited on the carrier net, to thereby subject the product ingredient to surface finishing. 20
6. A method as defined in claim 5, characterised in that pressing of the product ingredient (34) deposited on the carrier net (58) by the present means (30) is carried out by vacuum suction on a side of the carrier net. 25
7. A method as claimed in claims 5 or 6, characterised in that said presser means (30) comprises a sheet-like presser of high extensibility. 30
8. A method as defined in claims 5, 6 or 7, characterised in that said depositing step and surface-finishing step are carried out in zones (36,40) separate from each other, respectively. 35
9. A method as defined in claims 5, 6 or 7, characterised in that said depositing step and surface-finishing step are carried out in the same zone. 40
10. An apparatus (22) for manufacturing a formed sheet product, characterised in that said apparatus comprises: 45
 - a forming cup (24) adapted to be downwardly evacuated to vacuum; 50
 - a carrier net (58) arranged in said forming cup and adapted to permit a product ingredient (34) of a liquid feedstock (28) to be deposited thereon;
 - a presser means (30) adapted to be put on the product ingredient deposited on said carrier net; and 55
 - pressure applying means to press the

presser means downwardly against the product ingredient on said carrier net.

11. An apparatus as defined in claim 10, characterised in that said carrier net (58) is arranged on a supporter (54) in said forming cup (24).
12. An apparatus as defined in claims 10 or 11, characterised in that said presser means (30) comprises a sheet-like presser of high extensibility.
13. An apparatus as defined in claim 12, characterised in that said presser means (30) comprises a rubber sheet.
14. An apparatus as defined in claim 13, characterised in that said rubber sheet (30) is so formed that at least a surface thereof pressed against the product ingredient (34) is smooth.
15. An apparatus as defined in claim 12, characterised in that said presser means (30) comprises a combination of a rubber sheet and a woven fabric.
16. An apparatus as defined in any of claims 10 to 13 or 15, characterised in that said presser means (30) is so formed that at least a surface thereof pressed against the product ingredient (34) is patterned.
17. An apparatus as defined in any of claims 10 to 16, characterised in that said pressure applying means comprises means for applying vacuum suction from below said presser means.
18. An apparatus as defined in any of claims 10 to 16, characterised in that said pressure applying means comprises a pressurised medium acting on an upper surface of said presser means.

FIG. 1

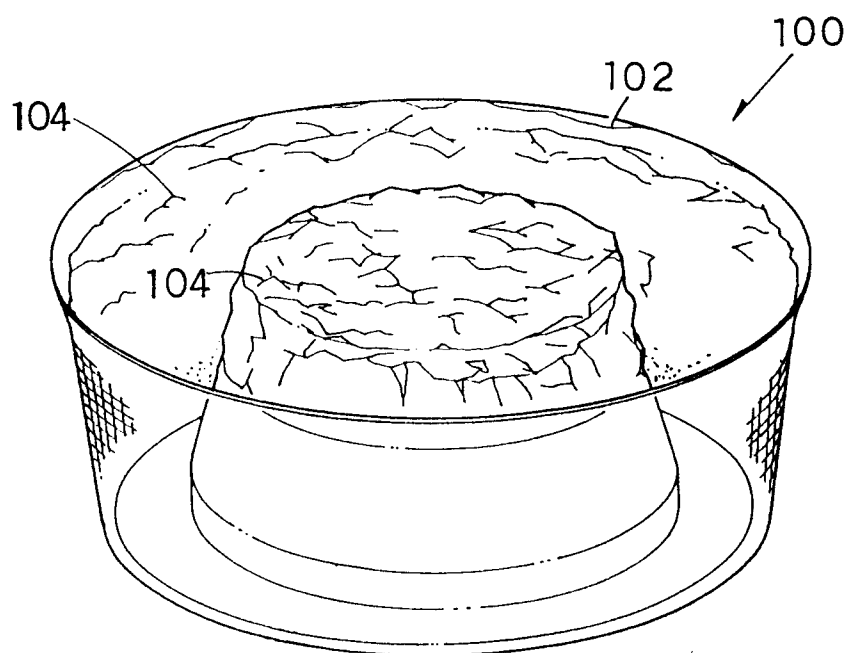


FIG. 3

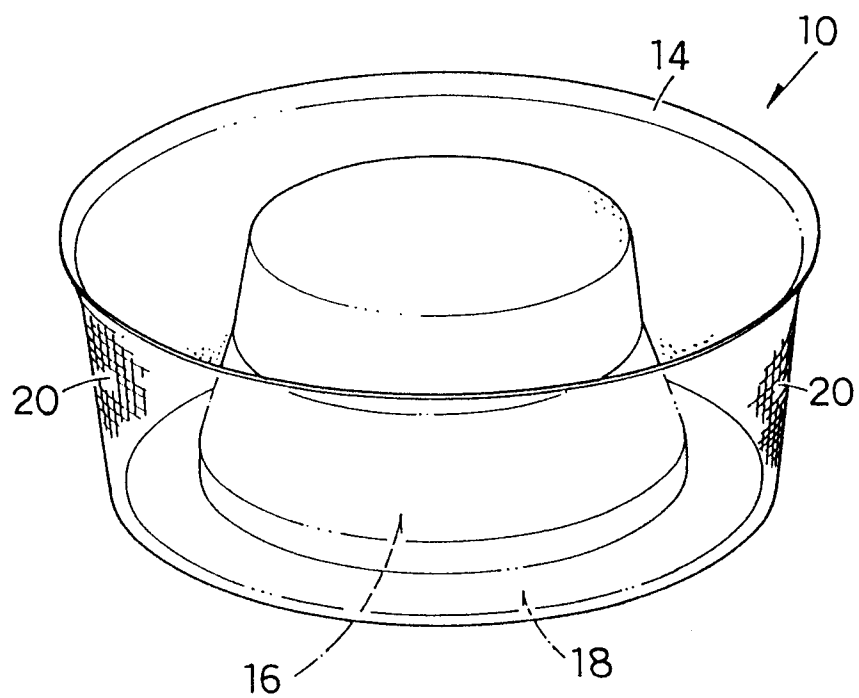


FIG. 2

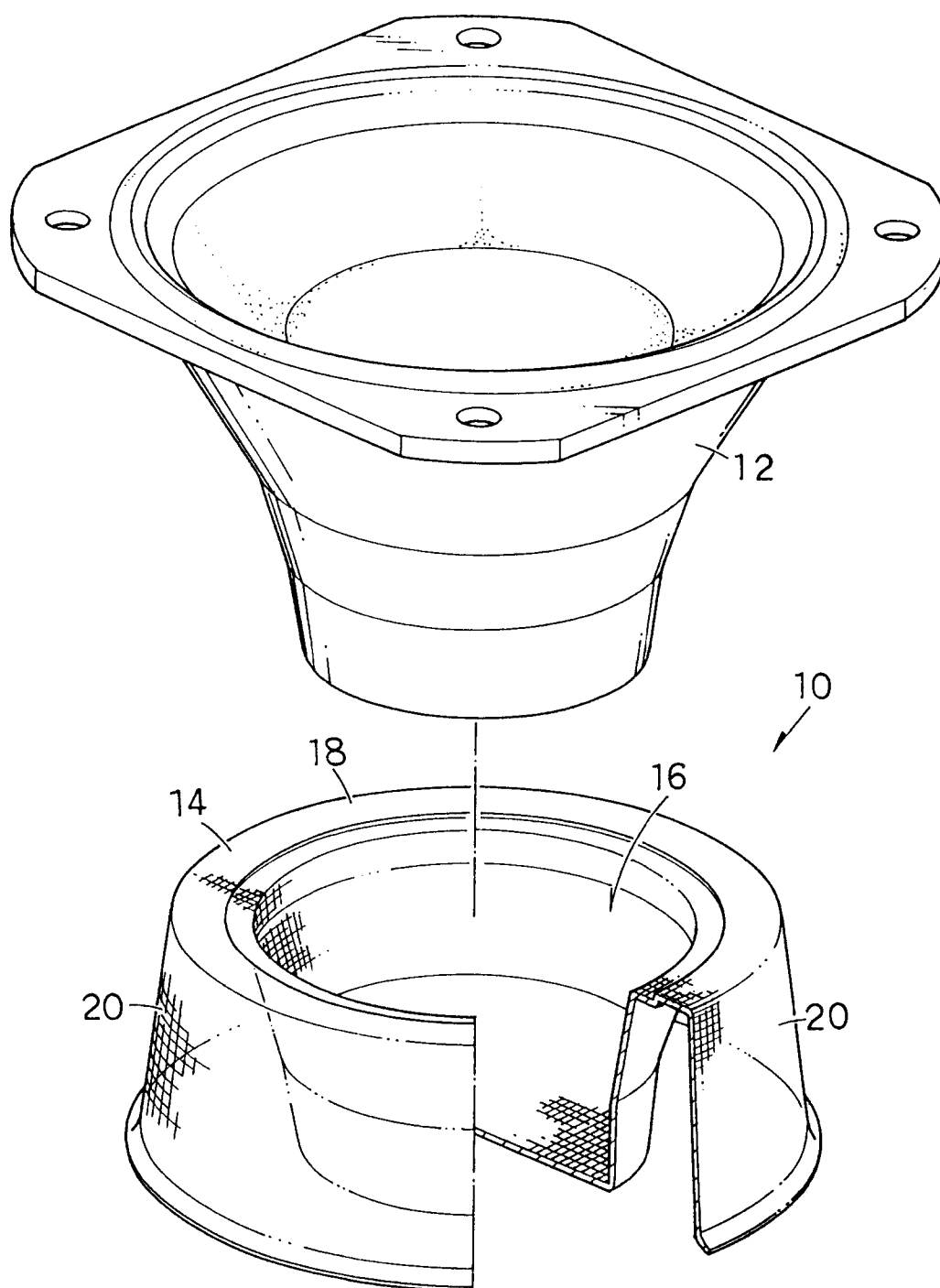


FIG. 4

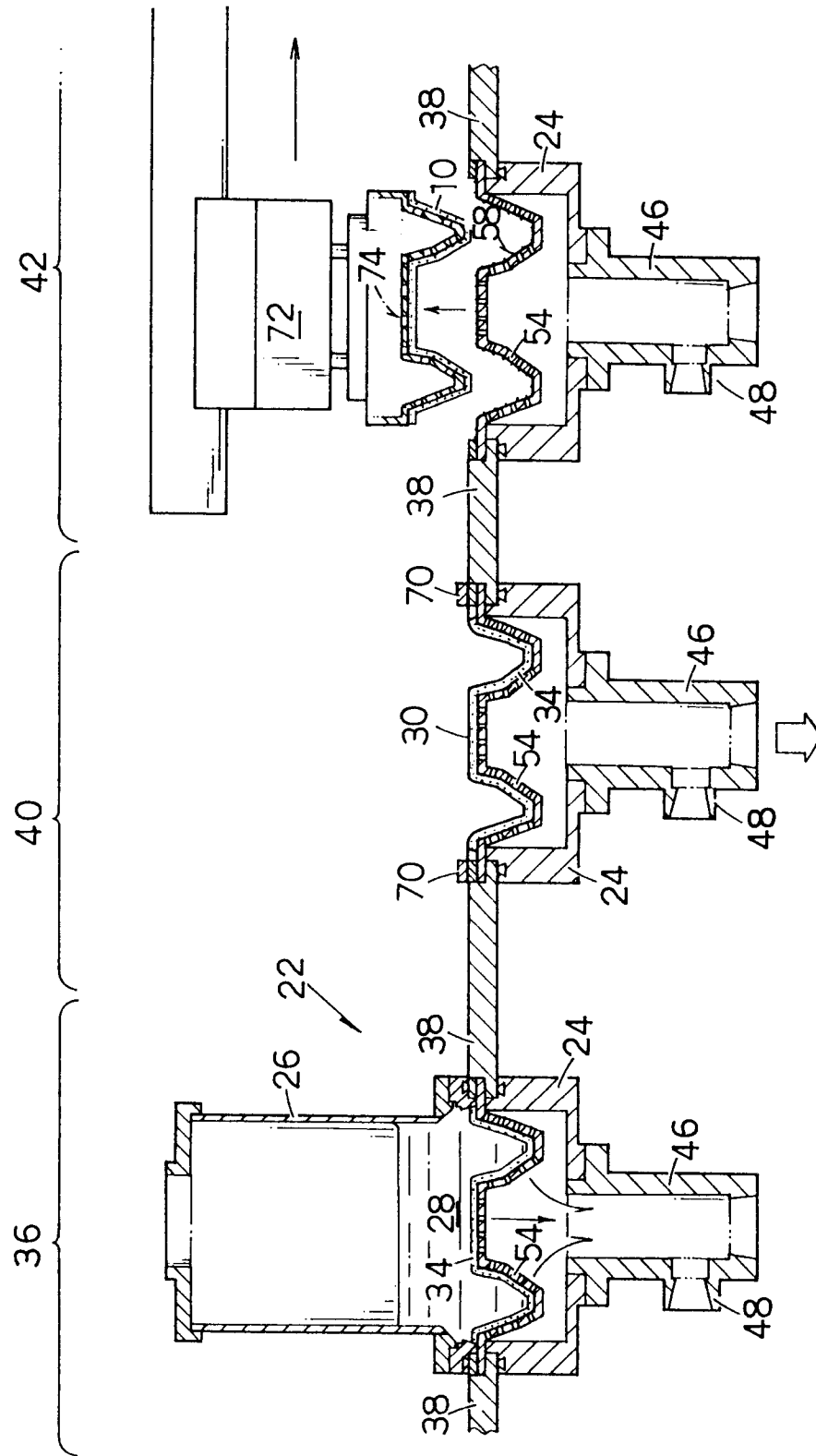


FIG. 5

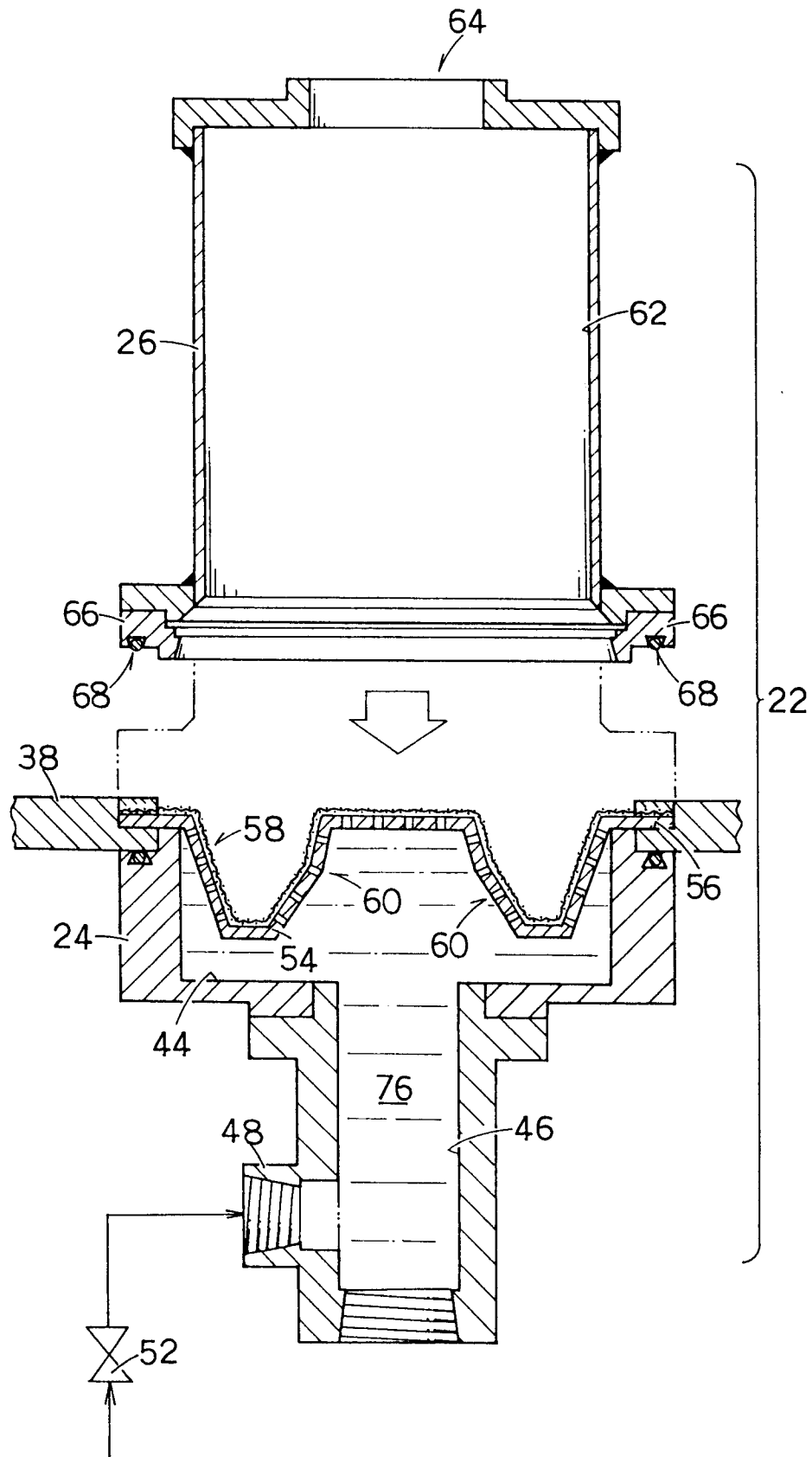


FIG. 6

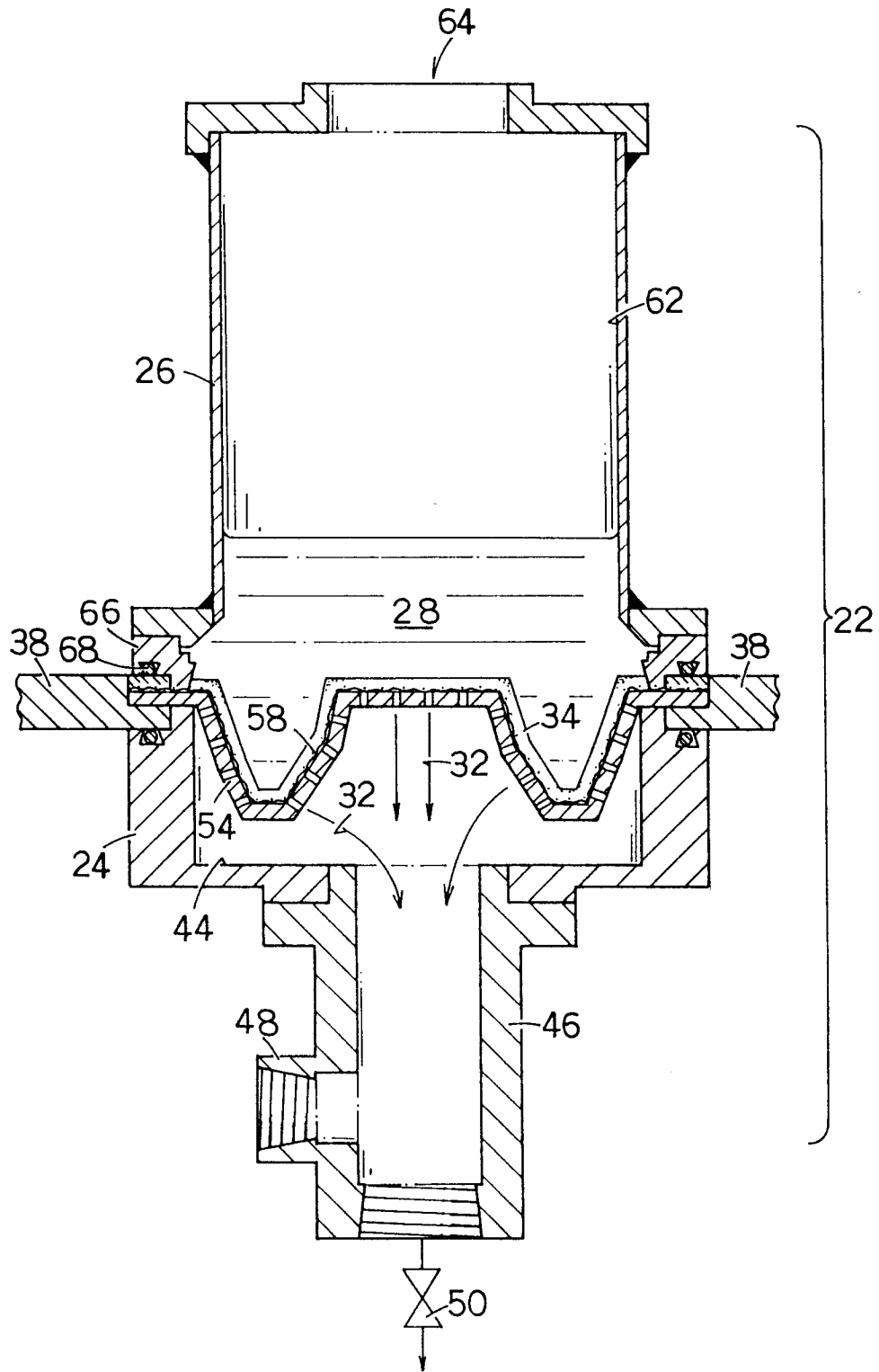


FIG. 7

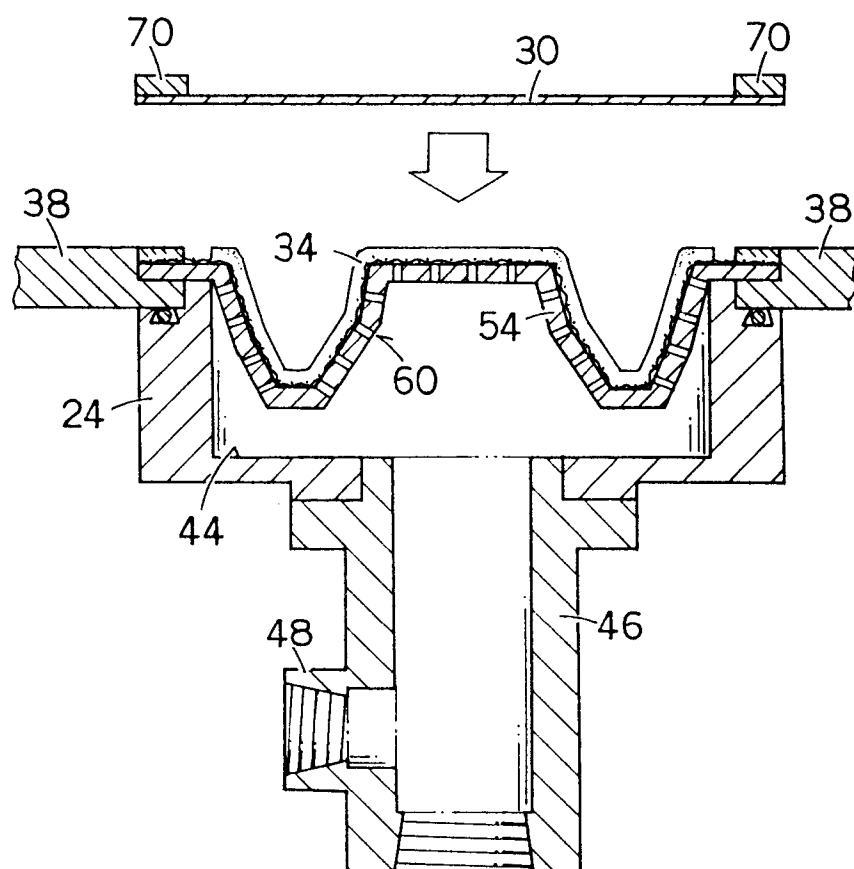


FIG. 8

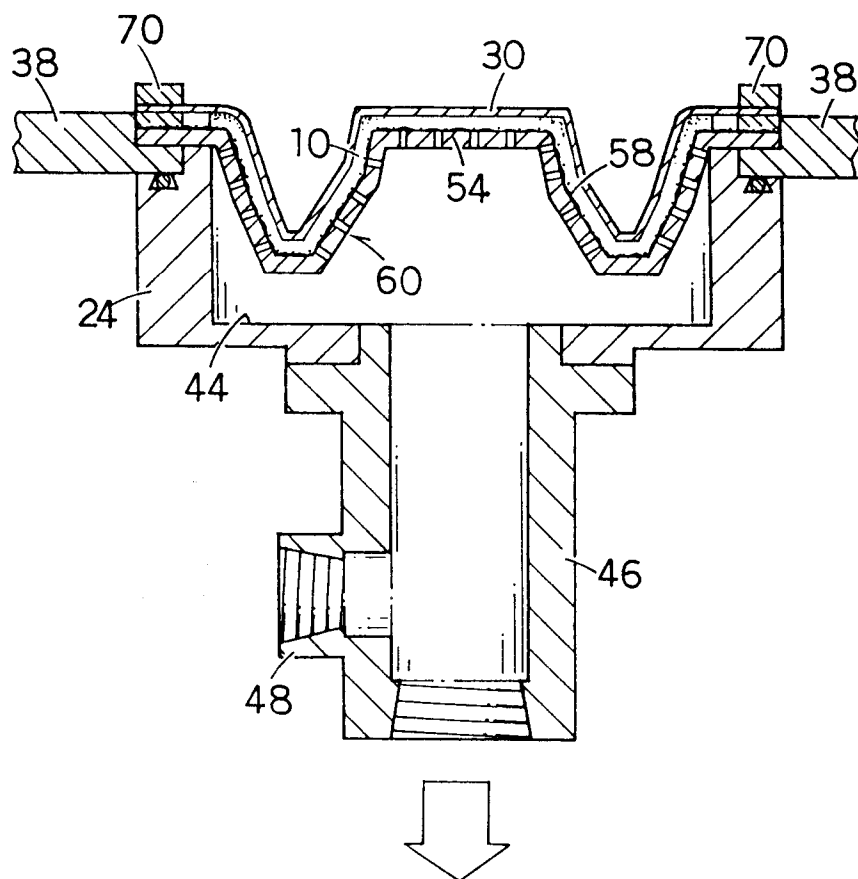
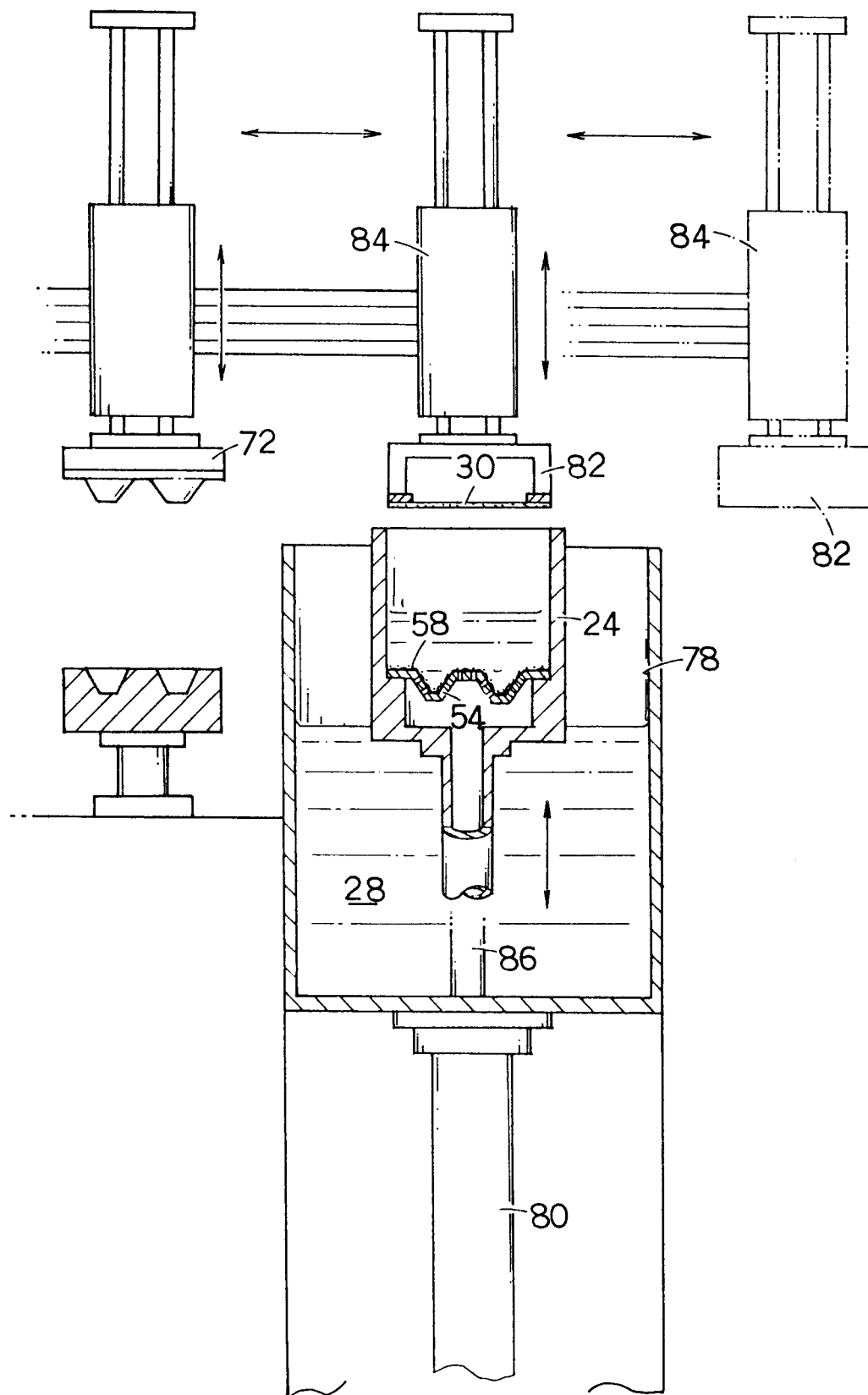


FIG. 9





European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 92 30 6159

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-A-1 436 951 (TSCHIRA) * the whole document * ---	1-8, 10-14,17	D21J7/00
X	CH-A-114 111 (SEAMAN CONTAINER MFG.) * the whole document * ---	1-5,7,8, 10-14,18	
A	DE-A-1 436 928 (DIAMOND INTERNATIONAL CORP.) * the whole document * ---	1-3,5,6, 8,10,11, 13-17	
A	US-A-2 990 314 (LEITZEL) * the whole document * ---	1,2,5,8, 10,14,18	
A	US-A-3 132 991 (HORNBOSTEL ET AL) * the whole document * ---	1,2,5,8, 10,11, 13,14,18	
A	FR-A-1 350 676 (EDNELL) ---		
A	BE-A-547 192 (HAWLEY PRODUCTS CIE) ---		TECHNICAL FIELDS SEARCHED (Int. Cl.5) D21J
A	BE-A-560 056 (DEUTSCHE FIBRIT GESELLSCHAFT EBERS & DR.MULLER) -----		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 29 OCTOBER 1992	Examiner DE RIJCK F.
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