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- (71) Applicant (for all designated States except US): USF JOHNSON SCREENS (NEWCASTLE) PTY LTD [AU/AU]; Macquarie Road, Warners Bay, NSW 2282 (AU).

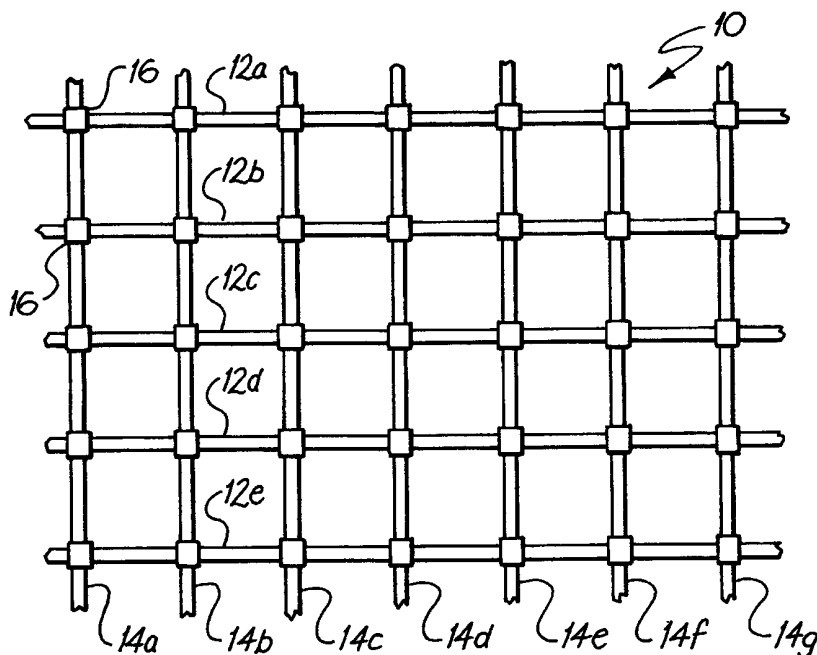
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- (72) Inventors; and
(75) Inventors/Applicants (for US only): EELES, John, William [AU/AU]; 14 Woodside Drive, Eleebana, NSW 2282 (AU). JOHNSON, Ronald, Leslie [AU/AU]; 37 Pillapai Street, Charlestown, NSW 2290 (AU).

(54) Title: MARINE PARTITION



(57) Abstract: Marine netting (10) which comprises a network of grid elements defining an array of openings, the network comprising an array of core elements (12a...12e, 14a...14g), elements (12a...12e, 14a...14g) or array being coated with layer of polyurethane incorporating an anti-fouling agent which is substantially non-toxic to marine life. The netting (10) may be manufactured in an open moulding process or by aligning and joining flexible members comprising a core element (12a) coated in polyurethane.



WO 00/74476 A1

MARINE PARTITION

Field of the Invention

This invention relates to marine netting and, in particular, but not exclusively to a marine partition formed from marine netting which is suitable
5 for use in aquaculture.

Background of the Invention

Aquaculture, which is more commonly known as fish farming, is an industry that is adversely affected by marine predators, typically large marine
10 animals such as sharks and seals. Nets are used to help prevent attacks on farmed fish by predators and also to keep farmed fish from escaping. In the past, nets woven from polypropylene have been used. However it is known that seals are able to tear large holes in polypropylene nets, which allows the seals access to the fish and also allows the farmed fish to escape. Actual
15 predator attacks and the threat of attacks by predators on farmed fish is also known to cause stress to the farmed fish which can adversely affect their growth, and in extreme cases cause death even to fish not physically injured by the attack. A further problem with polypropylene netting is that it has a useful working life of only two years when used in aquaculture. Woven nets
20 also have a tendency to become tangled when handled.

Outer perimeter fences have been proposed for the purposes of keeping predators away from fish pens. The diameter of the mesh for such outer perimeter fences can be much larger than the netting used to form the fish pens since the perimeter fences are only required to keep the larger predators
25 out rather than keep the smaller farmed fish in. Heavy duty metallic, cyclone chain mesh, and shark mesh have been considered for this purpose. There a number of problems which occur if such a mesh is used. First, metal nets tend to corrode when the mesh is under water for long periods of time, particularly if the water is sea water. Secondly, steel nets encourage rapid weed growth
30 and collect large weed masses and encrustations of marine organisms which must be regularly cleaned by a trained diver. Steel nets are expensive and are also heavy and quite stiff which make handling such nets difficult.

AU 637128 discloses one attempt to solve this problem comprising a semi-rigid moulded polyurethane network of grid elements defining an array of
35 openings. Although this system has the advantage that it is less dense than steel and consequently easier to raise and lower in water, the system lacks the

strength and durability of steel, and it is awkward to assemble the panels together into a marine module.

Marine netting does have other aquaculture functions and may be used for other aquaculture products such as oyster trays and the present invention
5 described below may be applied to a variety of aquaculture uses.

It is an object of the present invention to alleviate the above mentioned disadvantages of the prior art and produce an improved marine partition.

Summary of the Invention

10 In a first broad aspect of the present invention there is provided marine netting comprising:

a network of grid elements defining an array of openings, the network comprising an array of core elements, the core elements or array being coated with layer of polyurethane incorporating an anti-fouling agent which is
15 substantially non-toxic to marine life.

The network may be formed from core elements pre-coated with polyurethane incorporating an anti-fouling agent.

Thus in a related aspect of the present invention, there is provided marine netting comprising:

20 an array of flexible members arranged to define a series of grid elements, including a first set of spaced-apart members extending generally parallel to one another in a first direction, and a second set of spaced-apart members extending generally parallel to one another in a second direction which is generally transverse to the first direction, the grid elements having corners
25 formed by intersections between a member extending in the first direction and a member extending in the transverse direction, each of the flexible members comprising an elongate core element coated with a polyurethane incorporating an anti-fouling agent, the flexible members being joined together at the intersections rather than being woven together.

30 In one embodiment, the elongate core element is a polyester strand.

In another preferred embodiment the elongate core element comprises a braided high strength artificial fibre such as vectran, although other similar high strength artificial fibres such as kevlar, could be used.

Various compounds may be used as the anti-fouling agent such as Irgarol
35 1051 or Nuocide 071.

The first flexible members may be joined to transversely intersecting second flexible members by use of a glue or adhesive.

Alternatively, the intersection may be embedded in a joint or block of polyurethane moulded around the intersection, in which case it is preferred
5 that the polyurethane block contains a highly active fungicide which does not migrate from the polyurethane host into the sea water.

In a further alternative embodiment the members may be joined together by ultrasonic welding.

The present invention has the advantage that the nets being largely
10 comprised of polyurethane which has a specific gravity of 1.1, are approximately the same density as sea water and thus are much easier to raise and lower from the water for installation, maintenance and repair, cleaning etc.

However, the use of the elongate core element increases the strength of
15 the partition and enables the diameter of the elongate elements of the module to be thinner than if the marine partition were merely formed from polyurethane. This allows the partition to be used for netting for smaller fishes as well as netting for larger fishes and for anti-predator netting.

The netting of the present invention may also be used for other
20 aquaculture functions aside from making marine partitions: for example oyster trays may be made from the netting.

One preferred method for forming the marine partition of the present invention involves aligning a first series of substantially parallel spaced-apart longitudinally extending flexible members, each member comprising an
25 elongate core element coated with polyurethane, each member being separated from its adjacent member by a gap, and a second series of spaced-apart substantially parallel members which extend generally transversely to the direction of the first members and are overlaid on the first members and are joined to the same at locations where the first and second members intersect
30 each other.

In one embodiment the transverse members are joined to the longitudinal members by means of an adhesive or, in a yet further alternative, by ultrasonic welding.

In a yet further alternative method, a series of moulds are formed around
35 the intersections, and the moulds are filled with polyurethane to encapsulate

the intersection between the longitudinal and transverse members and join the one to the other.

In a preferred method, the longitudinal members are supported by a drum or a flat bed on which a series of lower mould parts are defined and the transverse members are overlaid on the longitudinal members above the lower mould parts and a moulding head defining an upper part of the mould is disposed on the intersection to define a mould about the same and polyurethane is injected into the mould thereby forming a polyurethane joint around the transverse and longitudinal members.

In a yet further embodiment, the marine netting or grid could be made from polyurethane in an open moulding process with the mould cavity defining a grid enclosing numerous openings. The method may include the step of placing a reinforcing net or grid inside the mould cavity during the moulding process. The reinforcement may be a woven or non-woven netting, the netting having a opening size which is slightly larger than the openings defined in the finished marine netting or grid.

Brief Description of the Drawings

A specific embodiment of the present invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 is a plan view of a marine partition embodying the present invention;

Figure 2 is a schematic sectional view of a coated synthetic strand for use in forming the partition shown in Figure 1;

Figure 3 is a schematic side view illustrating the method of joining transverse and longitudinally extending flexible members shown in Figure 1 together to form a marine partition;

Figure 4 illustrates schematically an apparatus used to form the marine partition of Figure 1;

Figure 5 illustrates a method of displaying a single strand on top of a series of longitudinally extending strands to form transversely extending elements for the partition shown in Figure 1;

Figure 6 illustrates a schematic cross-section through a second embodiment of a marine net;

Figure 7 is a plan view of a third embodiment of a marine net; and

Figure 8 is a section on lines VIII - VIII of Figure 7.

Detailed Description of Preferred Embodiments

Referring to the drawings, Figure 1 illustrates a marine partition
5 generally indicated at 10. The partition includes a series of parallel spaced-
apart elongate flexible members 12a.....12e extending in a first direction, say
the longitudinal direction. Laid on top of that first series of longitudinally
extending elongate flexible members, is a second series of elongate flexible
members 14a, 14b.....14e which extend in a direction generally transverse to
10 the longitudinal direction, the members being equi-distantly spaced apart.

The members are joined together at the locations where each
intersection between a longitudinal and a transverse member by polyurethane
which is moulded around the intersection.

In the embodiment shown, the elongate member comprises a
15 commercially available core of stranded vectran 18, an artificial carbon based
fibre, coated with an ether based polyurethane layer 20.

Figure 3 illustrates the joining of the elongate flexible members together
in more detail. The joint is made by moulding a block of polyurethane 16
around the intersection between a longitudinally extending member, say 12e,
20 and a transversely extending member, say 14a.

Instead of using vectran, other carbon fibres such as kevlar could be
used. In some cases polyurethane or polyester would also be suitable as a
core, particularly for nets having smaller grid elements. The size of the
openings in the grid will vary depending on the size of the marine animals
25 which the net is intended to either enclose or keep out. Typically the opening
sizes range from 300mm square to 25mm square. The larger opening sizes are
used to keep predators out and need to be stronger. The smaller opening sizes
are used to retain smaller farmed fish and do not need to be as strong.

The polyurethane coating contains an anti-fouling additive typically
30 Irgarol 1051 or Nuocide 1071, which is non-toxic to marine life.

The ether based polyurethane joint contains a highly active fungicide
which is locked to the polyurethane and does not migrate therefrom.

Figures 4 and 5 schematically illustrate one possible method for forming
the marine partition from the coated strands in which a series of coated strands
35 12a.....12e.....12n are equal distantly spaced apart on the surface of a rotatable
drum 30. The drum defines a grid of spaced apart moulds 32. The moulds are

spaced apart at a distance which defines the net or mesh opening size. A moveable indexable head 40 is disposed above the barrel and defines one or more upper mould elements 42 adapted to be superposed on the lower mould elements to form a complete mould. The head can then inject polyurethane into the mould space formed by the lower part 32 and upper part 42 of the mould around the intersection between the longitudinally extending elongate member and the transversely extending elongate member. The head may define a single or multiple spaced-apart upper mould elements.

Figure 5 illustrates one way of laying the transversely extending members on which a single elongate member 50 is crossed backwards and forwards over an array of longitudinal members 12a....12d.

In an alternative method, instead of a drum, a flat bed could be used.

The vectran coated member may be formed by tensioning the vectran and pulling the braided vectran "strand" through a thermosetting heated die into which ether based polyurethane is injected to coat the fibre.

The marine partition coating may be coloured in a shark repellent colour to discourage sharks from approaching the marine partition.

The netting of the present invention is much more flexible than those forms of existing netting with the exception of woven polypropylene which has problems of lack of durability and a tendency to tangle. The coating of polyurethane makes the partition very slippery and discourages weed growth and growth of marine organisms on the partition.

Although one preferred method of the present invention involves moulding a joint or block of polyurethane around intersections between the longitudinal end transversely extending members, in one embodiment it would be possible to simply join the members at the intersections with a suitable adhesive, alternatively, the members could be joined by welding e.g. sonic welding.

Figure 6 illustrates such an embodiment in which the members 14a, 14b.... and 12a.... are joined by glue or welding.

The smaller diameter nets may be made from a non braided core element, such as polyurethane or polyester. The marine partitions of the present invention may be used to make enclosures for retaining fish, such as the fish rearing enclosure disclosed in AU 506632 or to make barriers to prevent predators reaching fishing enclosures such as are shown in AU 637128, to make oyster trays or for other aquaculture applications.

In an alternative embodiment, illustrated in Figures 7 and 8 the marine netting may be made by an open moulding process. A mould cavity (not shown) defines a network of grid elements and polyurethane including anti-fouling agent is poured into the mould and allowed to set which results in a moulded polyurethane network of grid elements 50 defining an array of openings 52 (refer to Figure 7). A net 54 which may be woven or non-woven or other reinforcing or the like is placed in the mould cavity with the openings of the net superposed over the apertures 52 to be defined by the mould so that the members of the resultant moulded grid element, include a reinforcing core 54.

The size of the openings P depend on the size of the fish or fish fry to be retained in the marine netting. The width w of the elements may typically be 1.0 mm to 12mm. The modules are round on one side and flat on the other to facilitate mould removal.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. Marine netting comprising:
a network of grid elements defining an array of openings, the network comprising an array of core elements, the core elements or array being coated
5 with layer of polyurethane incorporating an anti-fouling agent which is substantially non-toxic to marine life.
2. Marine netting as claimed in claim 1 wherein the network comprises an array of flexible members including a first set of spaced-apart flexible members extending generally parallel to one another in a first direction, and a second set
10 of spaced-apart members extending generally parallel to one another in a second direction which is generally transverse to the first direction, the grid elements having corners formed by intersections between a member extending in the first direction and a member extending in the transverse direction, each of the flexible members comprising an elongate core element coated with a
15 polyurethane incorporating an anti-fouling agent, the flexible members being joined together at the intersections rather than being woven together.
3. Marine netting as claimed any preceding claim wherein the elongate core element is a polyester strand.
4. Marine netting as claimed in claim 1 or claim 2 wherein the elongate
20 core element comprises a braided high strength artificial fibre.
5. Marine netting as claimed in any preceding claim wherein the first set of flexible members are joined to one of the transversely intersecting second flexible members by use of an adhesive.
6. Marine netting as claimed in any one of claims 1 to 4 wherein the
25 intersections and are embedded in a block of polyurethane moulded around the intersection wherein the polyurethane block contains fungicide which does not migrate from the polyurethane host into the sea water.
7. Marine netting as claimed in any one of claims 1 to 4 wherein the members are joined together by ultrasonic welding.
- 30 8. A method for forming marine netting as claimed in any one of claims 2 to 7 including the steps of aligning a first series of substantially parallel spaced-apart longitudinally extending flexible members, each member comprising an elongate core element coated with polyurethane, each member being separated from its adjacent member by a gap, and a second series of
35 spaced-apart substantially parallel members which extend generally transversely to the direction of the first members and are overlaid on the first

members and are joined to the same at locations where the first and second members intersect each other.

9. A method as claimed in claim 8 wherein the transverse members are joined to the longitudinal members by means of an adhesive.

5 10. A method as claimed in claim 8 wherein the transverse members are joined to the longitudinal members by ultrasonic welding.

11. A method as claimed in claim 8 including the steps of forming a series of moulds around the intersections, and filling the moulds with polyurethane to encapsulate the intersection between the longitudinal and transverse
10 members and join the one to the other.

12. A method as claimed in claim 11 wherein the longitudinal members are supported by a drum or a flat bed on which a series of lower mould parts are defined and the transverse members are overlaid on the longitudinal members above the lower mould parts and a moulding head defining an upper part of
15 the mould is disposed on the intersection to define a mould about the same and polyurethane is injected into the mould thereby forming a polyurethane joint around the transverse and longitudinal members.

13. Marine netting as claimed in claim 1 wherein the network is made from polyurethane in an open moulding process using a mould cavity defining a
20 grid and wherein the core elements are placed in the mould cavity during the moulding process.

14. Marine netting as claimed in claim 13 wherein the core elements are in the form of a net.

15. Marine netting as claimed in claim 14 wherein the net is woven.

25 16. Marine netting as claimed in claim 15 wherein the net is non-woven.

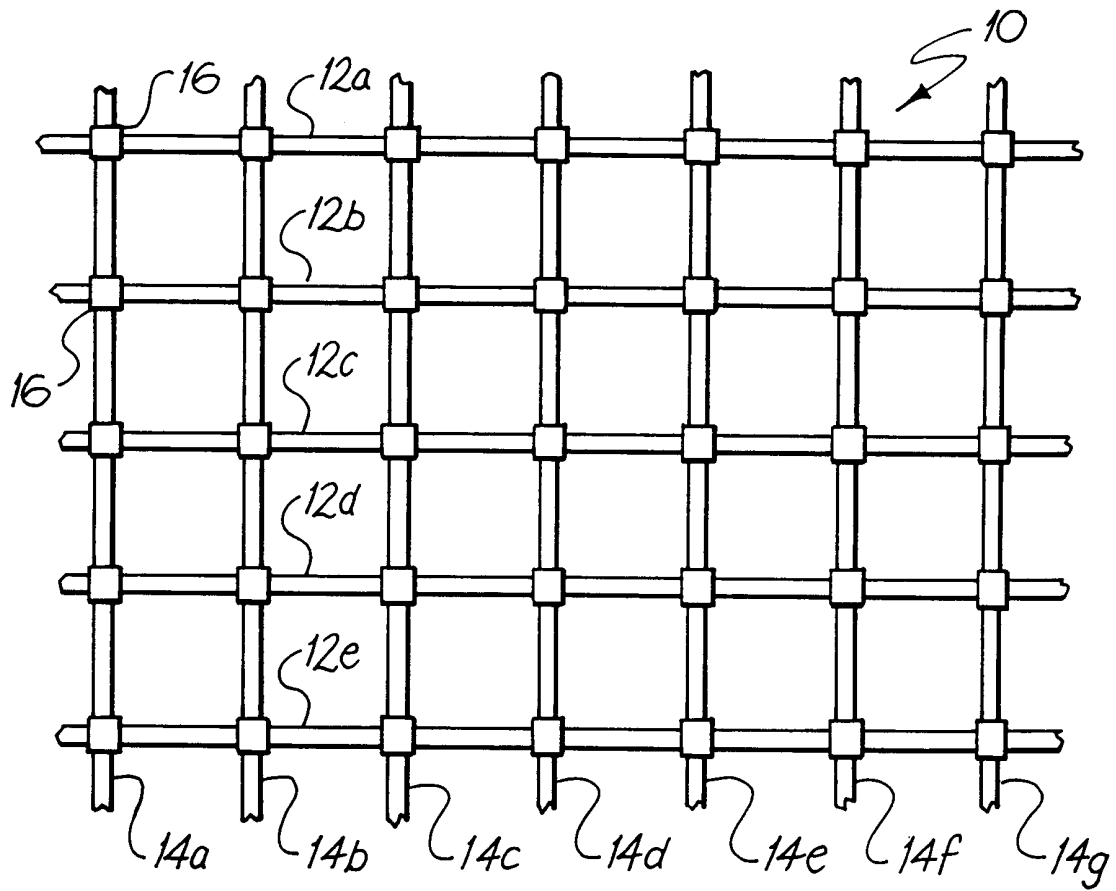


FIG. 1

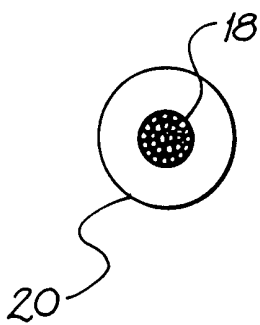


FIG. 2

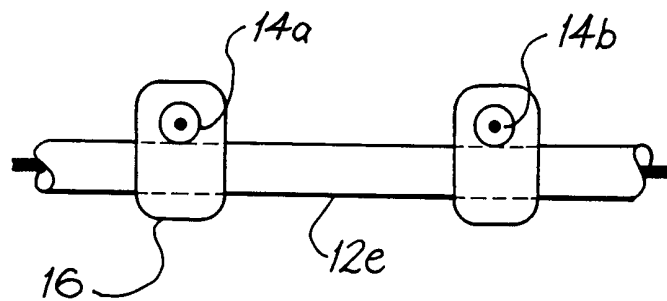


FIG. 3

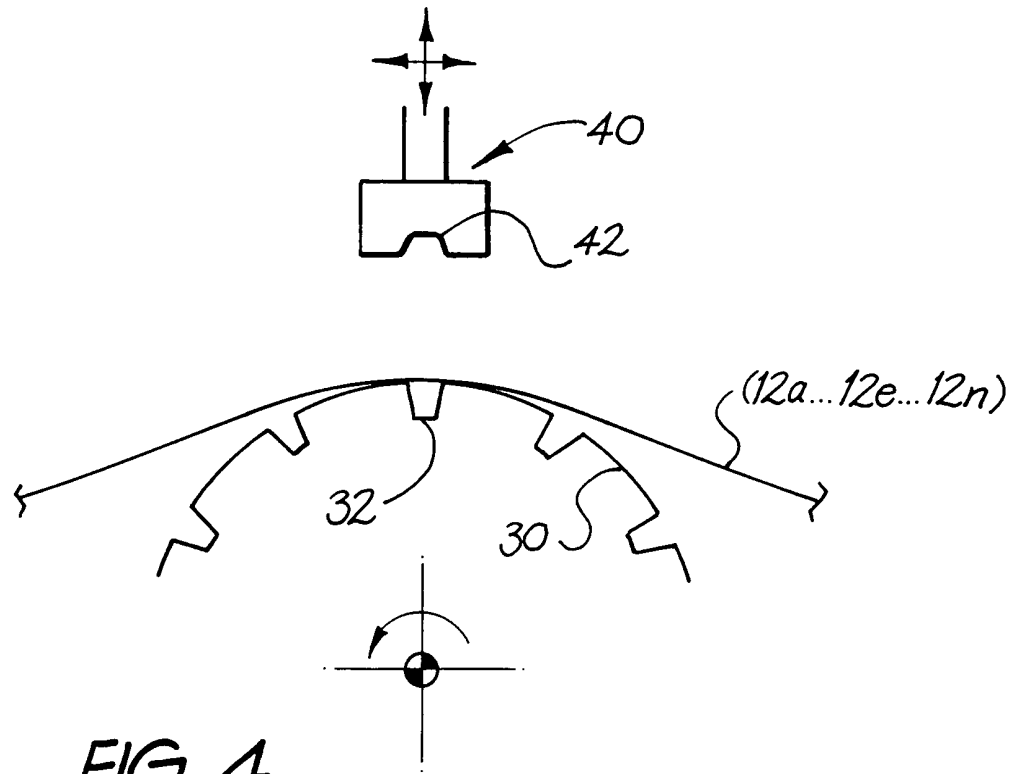


FIG. 4

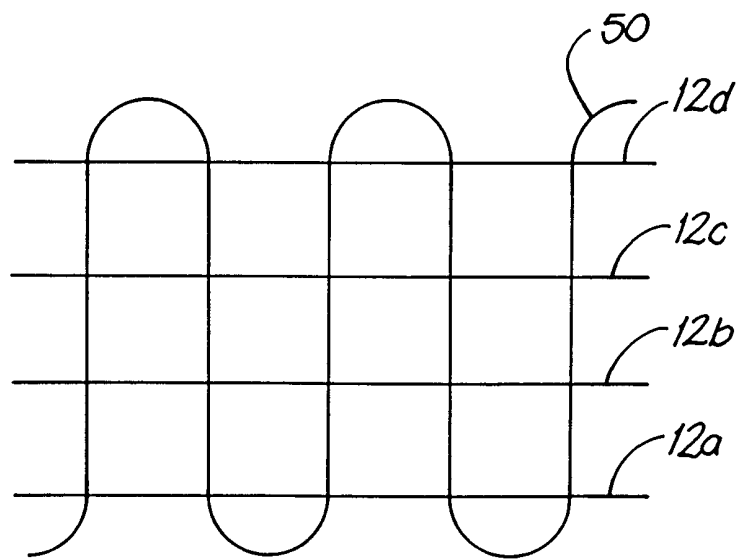


FIG. 5

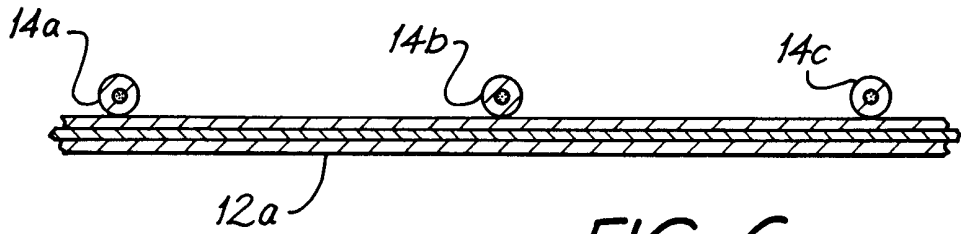


FIG. 6

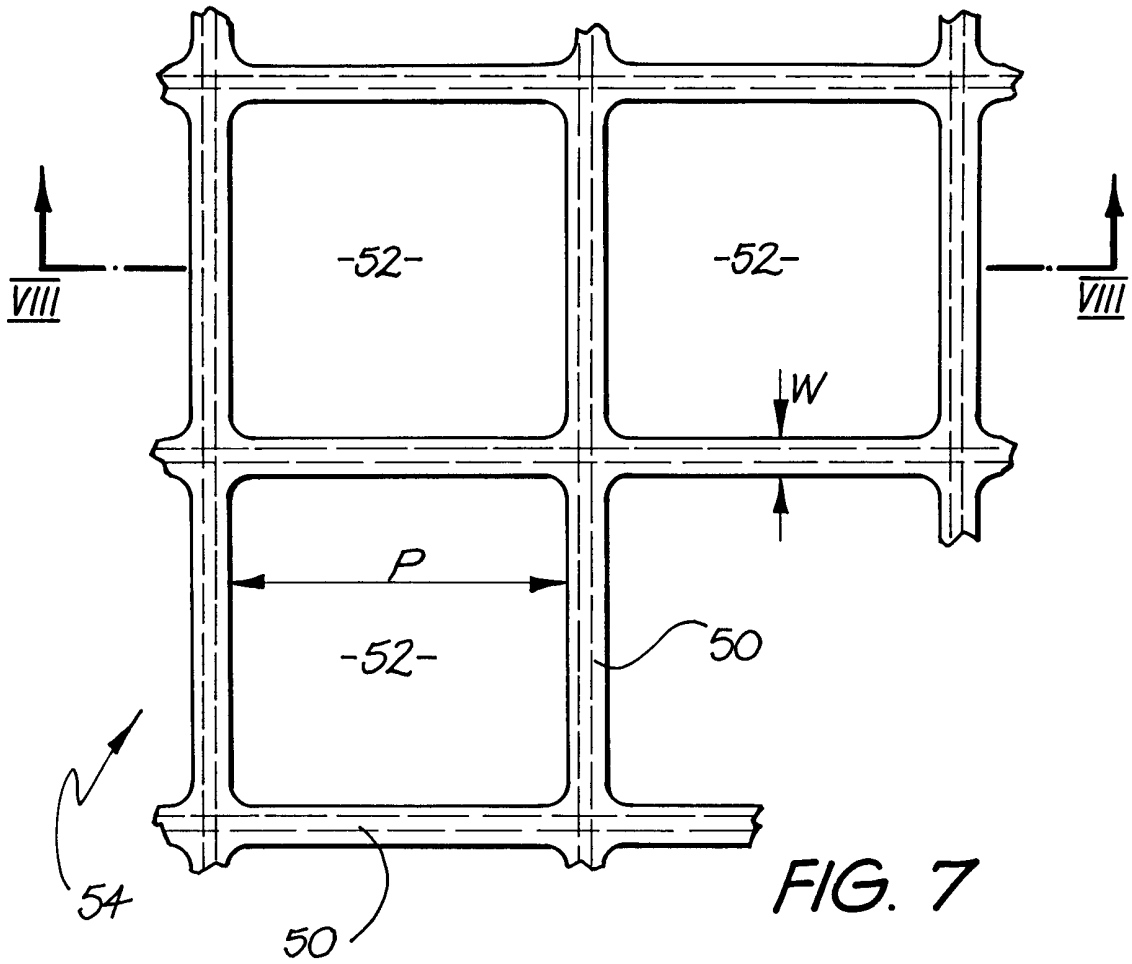


FIG. 7

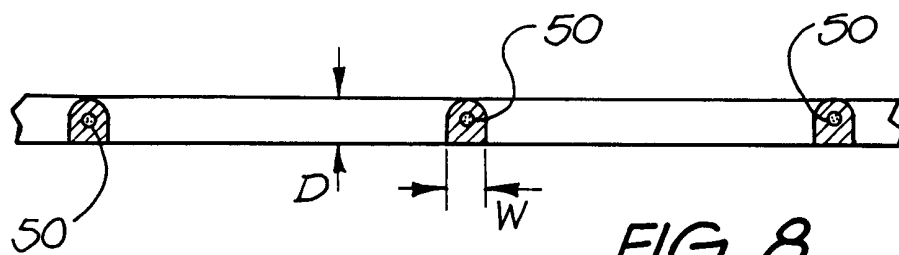


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00611

A. CLASSIFICATION OF SUBJECT MATTER				
Int. Cl. ⁷ : A01K 63/00				
According to International Patent Classification (IPC) or to both national classification and IPC				
B. FIELDS SEARCHED				
Minimum documentation searched (classification system followed by classification symbols) IPC A01K 63/00				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU : IPC as above				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) DWPI				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	Patent Abstract of Japan, JP, 10165045 A (TORAY IND INC) 23 June 1998 Whole abstract	1-16		
Y	Patent Abstract of Japan, JP 3080036 A (MOTONOBU MATSUMOTO) 4 April 1991 whole document	1-16		
Y	AU 60885/90 (637128) B (HUNTER PRODUCTS LIMITED) 13 February 1992 Whole document	1 -16		
<input type="checkbox"/> Further documents are listed in the continuation of Box C <input type="checkbox"/> See patent family annex				
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