(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 532 920 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.05.2005 Bulletin 2005/21

(51) Int Cl.[7]: **A47L 15/50**

(21) Application number: **04105414.9**

(22) Date of filing: **29.10.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **14.11.2003 US 713364**

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(54) Dishwasher with electrocoated dishrack

(57) The invention relates to a dish rack (30) with a protective coating (50) comprising an electrocoated layer (54) and a polymer layer (58). The coating also includes a base corrosion-resistant layer (52) on the metallic dish rack (30) and a primer layer (56) adjacent to the electrocoated layer (54) to improve adhesion of the polymer layer (58). The aesthetically appealing exterior coating protects the dish rack (30) from corrosion and from corrosion propagation.

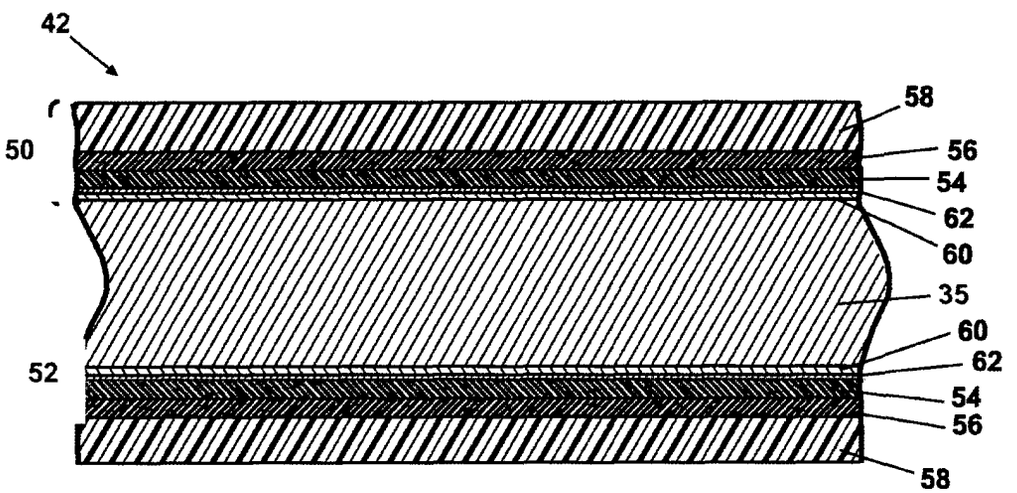

Fig. 4

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention relates to a dish rack with a protective coating and, more particularly, to a dish rack with a protective coating comprising an electrocoated layer.

Description of the Related Art

[0002] Household dishwashers are typically equipped with at least one dish rack for holding dishes, such as plates, bowls, utensils, glassware, pots, pans, and the like. Most dish racks comprise a plurality of interconnected wires that form a basket with several tines for supporting the various dishes. The wires are commonly made of metal, such as steel, coated with a protective material, usually nylon or polyvinyl chloride (PVC). The nylon or PVC provides a physical barrier over the wires to protect the metal from exposure to water and wash aids, including detergents and rinse aids, in the dishwasher environment. As a result, the protective layer helps prevent corrosion, or rusting, of the dish rack.

[0003] Unfortunately, the protective layer does not always provide a sufficient shield, and the metallic wires of the dish rack can rust in the harsh dishwasher environment. The metal can become exposed if the integrity of the polymer is compromised as a result of aging of the material or physical destruction, such as scratching, which can occur during the loading of the dishwasher, especially when knives and other sharp items are loaded into the dishwasher. Additionally, deficiencies in the coating process can lead to non-uniform, defective layers that are susceptible to corrosion. Once corrosion initiates, the destructive process tends to propagate along the wires.

[0004] Rusted dish racks are the most prevalent consumer complaint relating to all household dishwashers, regardless of producer. Dish rack replacement costs tend to be fairly high, and, in some cases, consumers choose to replace the entire dishwasher rather than purchase a replacement rack.

SUMMARY OF THE INVENTION

[0005] The invention addresses the deficiencies of the prior art and a dish rack having an exterior coating that protects the dish rack from environmental degradation. One embodiment of the invention is a dish rack for an automated dishwasher comprises a metal frame configured to support dishes and an exterior coating covering at least a portion of the metal frame. The exterior coating comprises an electrocoated layer on the metal frame and a polymer layer on the electrocoated layer. The exterior coating protects the metal frame from corrosion while providing an aesthetic appearance.

[0006] The electrocoated layer can be non-metallic and/or a paint layer. The polymer layer is can be a thermoplastic, the thermoplastic can be a non-hydrocarbon carbon chain polymer, and non-hydrocarbon carbon chain polymer can be a polyvinyl chloride. The thermoplastic can also be a polyvinyl chloride blend.

[0007] The metal frame comprises a wire-form having multiple interconnected wires and defining a bottom wall and a peripheral wall extending upwardly from the bottom wall to form an open-top, dish-holding recess. The wire form further comprises at least one set of tines located within the dish-holding recess. The entire metal frame can be covered by the exterior coating.

[0008] The exterior coating further comprises a primer layer between the electrocoated layer and the polymer layer. The primer layer comprises a non-water-based primer, such as an acetone-based primer or a methyl ethyl ketone-based primer.

[0009] The exterior coating further comprises a corrosion-resistant layer between the electrocoated layer and the metal frame. The corrosion-resistant layer comprises a zinc phosphate layer and a tri-chrome sealer layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In the drawings:

[0011] FIG. 1 is a perspective view of an automated dishwasher equipped with dish racks according to the invention;

[0012] FIG. 2 is a perspective view of one of the dish racks of FIG 1 and showing a wire form and several tines;

[0013] FIG. 3 is an enlarged transverse sectional view of one of the tines of the dish rack of FIG. 2; and

[0014] FIG. 4 is an enlarged longitudinal sectional view of the tine of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] The invention addresses the problems of the prior art and provides a dish rack with an exterior coating that protects the dish rack from environmental degradation and affords an aesthetic appearance. The coating includes a robust electrocoated layer and an outer polymer layer that impart exceptional corrosion resistance to the dish rack

[0016] Referring now to the figures and to FIG. 1 in particular, a typical automated dishwasher 10 comprises a housing 11 for a wash tub 12. The wash tub 12 has spaced top and bottom walls 14 and 16, spaced side walls 18 generally orthogonal to the top and bottom walls 14 and 16, and a rear wall 20 substantially orthogonal to the top and bottom walls 14 and 16 and to the side walls 18. The walls 14, 16, 18, and 20 join along their respective edges to define a wash chamber 22 with an open face 23. The side walls 18 each have a shelf 19 that extends in towards the wash chamber 22. A door 24 is hingedly mounted to the dishwasher 10 and can

move between an open condition, as illustrated in FIG. 1, to permit access to the wash chamber 22 and a closed condition (not shown) to close the wash chamber 22 by covering the open face 23 of the wash chamber.

[0017] Additionally, the dishwasher 10 comprises a liquid recirculation system 26 for introducing and recirculating liquid and wash aids, such as detergents, rinse aids, and the like, throughout the wash chamber 22. The features of liquid recirculation systems are well known and are not germane to the invention. Therefore, they will not be described in further detail. An example of a liquid circulation system is provided in U.S. Patent No. 6,418,943, which is incorporated herein by reference in its entirety.

[0018] The dishwasher 10 is equipped with at least one, and usually two, dish racks 30. Slide rails 28 are disposed inside the wash tub 12, preferably on the side walls 18, for slidably mounting at least one of the dish rack 30 to the wash tub 12. The dish rack 30 disposed in the lower portion of the wash tub 12 has wheels 31 that ride on the shelf 19 formed in the side walls 18. The shelf 19 is aligned with the upper surface of the door 24 when the door 24 is in the open condition so that the dish rack 30 can roll onto the door. The dish racks 30 can slide between a wash position, as shown by the upper dish rack 30 in FIG. 1, wherein the dish rack 30 is disposed inside the wash chamber 22, and a load/unload position, as shown by the lower dish rack 30 in FIG. 1, wherein at least a portion of the dish rack 30 is outside the wash chamber 22.

[0019] Dish racks 30 are well known structures for holding various types of dishes, including plates, bowls, glassware, utensils, pots, pans, and the like. For purposes of this patent application, the term dish or dishes is generic and is intended to refer to any item that might be placed into a dishwasher for cleaning, including those items listed above.

[0020] As illustrated in FIG. 2, the dish rack 30 has a metal frame comprising a plurality of interconnected wires 34 that constitute a wire form 32. The wire form 32 is a basket-like structure that defines a bottom wall 36 and an upwardly extending peripheral wall 38. Typically, the peripheral wall 38 is generally square or rectangular, depending on the shape of the wash chamber 22. Together, the bottom wall 36 and the peripheral wall 38 form an open-top recess 40 for holding dishes.

[0021] At least one, and usually more than one, set of tines 42 extend from the wire form 32 into the recess 40. For example, the sets of tines 42 can extend upwardly from the bottom wall 36 or inwardly from the peripheral wall 38, and they can be fixedly or pivotally mounted to the wire form 32. The set of tines 42 provides a support onto which or between which dishes can be situated and can comprise one tine or multiple tines. Preferably, the sets of tines 42 are configured to accommodate an efficient and effective dish arrangement wherein the volume of dishes in the dish rack 30 is maximized without detracting from the cleaning performance of the dishwasher 10. In addition to the sets of tines 42, the dish rack 30 can comprise other components, for example a separate utensil rack, special supports for delicate glassware, such as wine glasses, or wire form shelves that are substantially parallel to the bottom wall 36 and provide a second tier within the recess 40. These other components can be made of a wire frame structure in the same manner as the dish rack 30.

[0022] Referring now to FIGS. 3 and 4, the wires 34 that comprise the dish rack 30, including the wire form 32 and the sets of tines 42, have a metal wire core 35, usually composed of some type of steel or iron alloy. A barrier in the form of an exterior coating 50 surrounds the wire core 35 to protect the metal from exposure to the wash chamber environment, which can include air, liquid, various types of wash aids, and heat. Bare metal in such an environment is highly susceptible to corrosion, which not only detracts from the appearance of the dish rack 30 but can also compromise the structural integrity of the dish rack 30.

[0023] The exterior coating 50 is a laminate comprising several layers: a base corrosion-resistant layer 52, an electrocoated layer 54, a primer layer 56, and a polymer layer 58. The combination of the layers 52, 54, 56, and 58 imparts exceptional corrosion resistance to the dish rack 30. It should be noted that in FIGS. 3 and 4, the diameter of the wire core 35 relative to the thickness of the exterior coating 50 is not to scale. Rather, the exterior coating is enlarged in order to provide a visible illustration of the individual layers 52, 54, 56, and 58.

[0024] The base corrosion-resistant layer 52 is immediately adjacent the metal wire core 35 and can comprise more than one sub-layer. In the illustrated embodiment, the corrosion-resistant layer 52 has a first sub-layer 60, preferably zinc phosphate, and a second, sealing sub-layer 62, preferably a tri-chrome sealer. The zinc phosphate sub-layer 60 forms a reactive microscopic surface to enhance paint bonding. A suitable commercially available zinc phosphate is Chemfos® 825R, available from PPG®. Other phosphates, such as iron phosphate, or other similar corrosion resistant and surface preparation chemicals can be utilized as an alternative for the first sub-layer 60. The tri-chrome sub-layer 62 seals the zinc phosphate sub-layer 60 to improve the adhesion of the subsequent electrocoated layer 54 and the corrosion resistance of the dish rack 30, and a exemplary commercial tri-chrome sealer is PPG® Chemseal® 18. Each sub-layer is preferably very thin, approximately 0.1 mil or less.

[0025] Adjacent the corrosion-resistant layer 52 is the electrocoated layer 54. Electrocoating is a well-known process for applying paint to surfaces. In short, the process involves submersing a part in a bath and applying an electrical current between the part and a counter electrode. Paint having a charge opposite of the part is attracted by the electric field and deposited onto the part to form an even corrosion resistant layer on the entire submersed surface of the part. The electrocoated layer

54, which is continuous and robust, serves as a critical barrier for the wire core 35 should the polymer layer 58 degrade or otherwise fail. In the event that the wires 34 are scratched to expose the bare metal, the electrocoated layer 54 prevents any corrosion on the scratched area from propagating along the wire cores 35. Examples of suitable paints for the electrocoated layer 54 include PPG® Polycron® 661, PPG® Polycron® 648, or other Polycron® 600 series paints. The electrocoated layer 54 on the dish rack 30 is preferably approximately 0.5-0.8 mils thick.

[0026] The primer layer 56 prepares the surface of the electrocoated layer 54 to facilitate adhesion of the polymer layer 58 thereto. While it is within the scope of the invention to utilize a water-based primer, a non-water-based primer is preferred. Exemplary suitable primers include acetone-based primers, such as Union City Industries #2100-4HO-X-000 Clear, and methyl ethyl ketone-based primers. Preferably, the primer layer 56 is approximately 0.5 -1 mils thick.

[0027] The outermost layer of the exterior coating 50 is the polymer layer 58, which contributes to the corrosion resistance and provides an attractive appearance for the dish rack 30. The polymer layer 58 can comprise any suitable polymeric material and is preferably thermoplastic. More particularly, the polymer layer 58 is preferably polyvinyl chloride (PVC), a PVC derivative, such as chlorinated PVC (CPVC), or a blend or copolymer of PVC and another polymer. PVC is a widely utilized non-hydrocarbon carbon-chain polymer with desirable chemical and mechanical properties. A suitable PVC is Union City Industries Ice Gray (K112) PVC #RV16653. The thickness of the polymer layer is preferably between 10 and 15 mils.

[0028] Nylon, another thermoplastic polymer, is commonly used as a coating on dish racks; however, at the present time, nylon is not the preferred material for use with the electrocoated dish rack 30 because nylon processing temperatures are sufficiently high enough that they can undesirably breakdown and crack the electrocoat paints. Nylon could be used if it could be applied in a manner that would not impair the protective nature of the electrocoated layer 54.

[0029] To apply the exterior coating to the dish rack 30, the metal wire form 32, the sets of tines 42, and any other dish rack components are initially subjected to several cleaning stages involving various cleaning chemicals and water. Next, the first sub-layer 60 of the corrosion resistant layer 52 is applied to the dish rack 30, which is subsequently rinsed before application of the sealing sub-layer 62. After the sealing sub-layer 62 is deposited, the dish rack 30 is again rinsed, and the electrocoated layer 54 is applied in the manner as described above. Following the electrocoating process, the dish rack 30 is rinsed, and the electrocoated layer 54 is cured and cooled. Next, primer is applied to the electrocoated dish rack 30. The primer layer 56 is then heated, and the polymer layer 58 is applied to the dish rack 30. After a post-heat treatment, the dish rack 30 is rapidly quenched to cool the polymer layer 58, impart a glossy appearance, and reduce potential defects.

[0030] While it is preferred that the entire dish rack 30, including the wire form 32, the sets of tines 42, and any other dish rack components, comprises the exterior coating 50, it is within the scope of the invention that only a portion of the dish rack 30 is protected by the exterior coating 50. Furthermore, the thickness and particular materials of the individual layers 52, 54, 56, and 58 and sub-layers 60 and 62 of the exterior coating 50 are not limited to the examples provided. The relative thickness of the individual layers 52, 54, 56, and 58 and sub-layers 60 and 62 can be adjusted to accommodate variables, such as the specific materials utilized and the geometry of the dish rack 30, so that the exterior coating 50 provides optimal protection to the dish rack 30.

[0031] The dish rack 30 according to the invention possesses superior corrosion resistance as a result of the exterior coating 50. The combination of the electrocoated layer 54 and the polymer layer 58 forms a robust barrier between the underlying metal wire cores 35 and the potentially destructive dishwasher environment. The polymer layer 58 physically shields the dish rack 30 from air, liquid, and wash aids while providing a pleasing appearance and surface texture. Because the electrocoated layer 54 is continuous, it prevents any undesirable communication between the metal wire cores 35 if defects are present in the polymer layer 58 or if the polymer layer 58 fails in any manner. Furthermore, if the polymer layer 58 and electrocoated layer 54 are scratched or otherwise locally removed, the superior adhesion of the electrocoated layer 54 prevents any subsequent corrosion from propagating to other areas of the dish rack 30. In comparison, corrosion in scratched regions of conventional dish racks coated with nylon or PVC tends to propagate throughout the dish rack. Ultimately, the inventive dish rack 30 has a reduced tendency to rust or fail, thereby leading to fewer consumer complaints and replacement dish racks.

[0032] While the invention has been specifically described in connection with certain specific embodiments thereof, it is to be understood that this is by way of illustration and not of limitation, and the scope of the appended claims should be construed as broadly as the prior art will permit.

Claims

1. A dish rack for an automated dishwasher, comprising:

   a metal frame configured to support dishes, and an exterior coating covering at least a portion of the metal frame and comprising:

   an electrocoated layer on the metal frame,

and

a polymer layer on the electrocoated layer;

whereby the exterior coating protects the metal frame from corrosion while providing an aesthetic appearance.

2. The dish rack according to claim 1 wherein the electrocoated layer is selected from a group consisting of a non-metallic, a paint layer, and a non-metallic paint layer.

3. The dish rack according to claim 1 wherein the polymer layer is a thermoplastic selected from a group consisting of a non-hydrocarbon carbon-chain polymer, a polyvinyl chloride, and a polyvinyl chloride blend.

4. The dish rack according to claim 1 wherein the metal frame comprises a wire-form having multiple interconnected wires.

5. The dish rack according to claim 4 wherein the wire form defines a bottom wall and a peripheral wall extending upwardly from the bottom wall to form an open-top, dish-holding recess.

6. The dish rack according to claim 5 wherein the wire form further comprises at least one set of tines located within the dish-holding recess.

7. The dish rack according to claim 1 wherein the entire metal frame is covered by the exterior coating.

8. The dish rack according to claim 1 wherein the exterior coating further comprises a primer layer between the electrocoated layer and the polymer layer.

9. The dish rack according to claim 8 wherein the primer layer is selected from a group consisting of a water-based primer, a non-water-based primer, an acetone-based primer, and a methyl ethyl ketone-based primer.

10. The dish rack according to claim 8 wherein the electrocoated layer is selected from a group consisting of a non-metallic, a paint layer, and a non-metallic paint layer.

11. The dish rack according to claim 10 wherein the polymer layer is a thermoplastic selected from a group consisting of a non-hydrocarbon carbon -chain polymer, a polyvinyl chloride, and a polyvinyl chloride blend.

12. The dish rack according to claim 11 further comprising a corrosion-resistant layer selected from a group consisting of an iron phosphate layer, a zinc phosphate layer, and a tri-chrome sealer layer between the electrocoated layer and the metal frame.

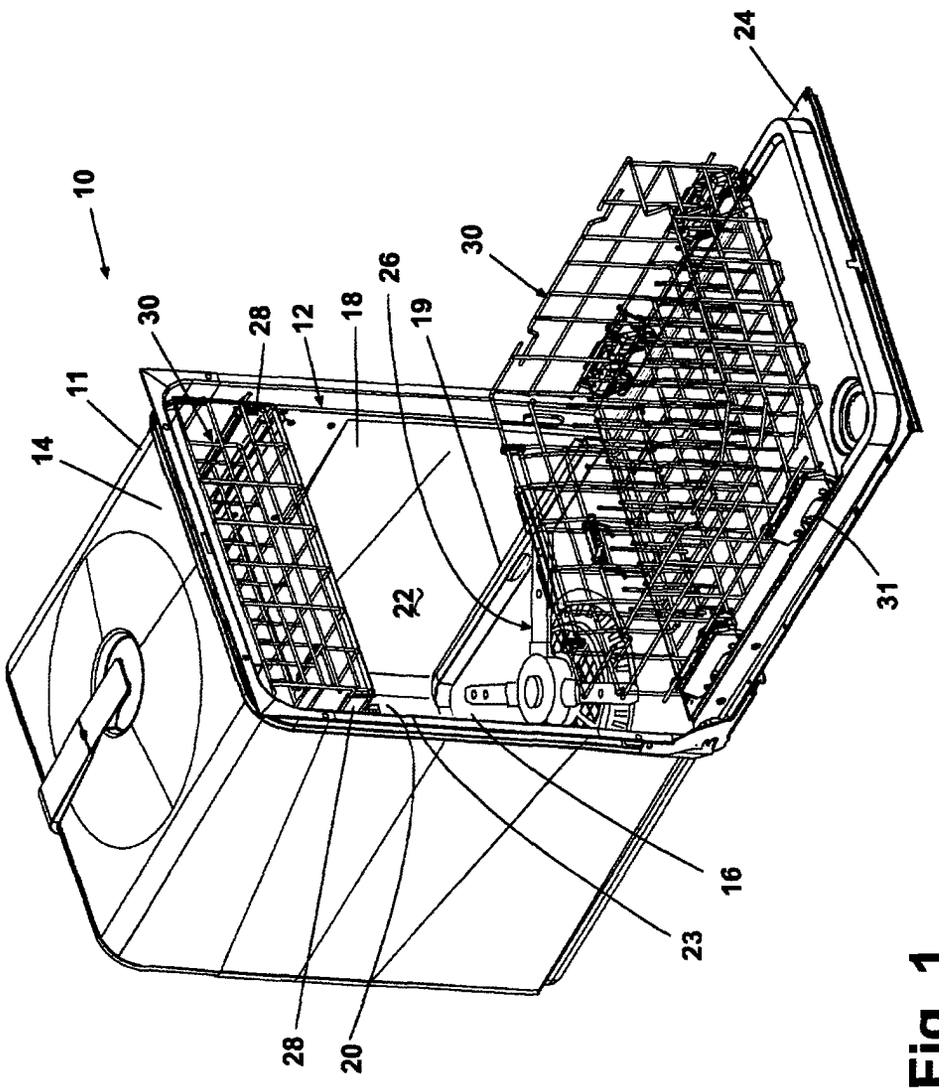

Fig. 1

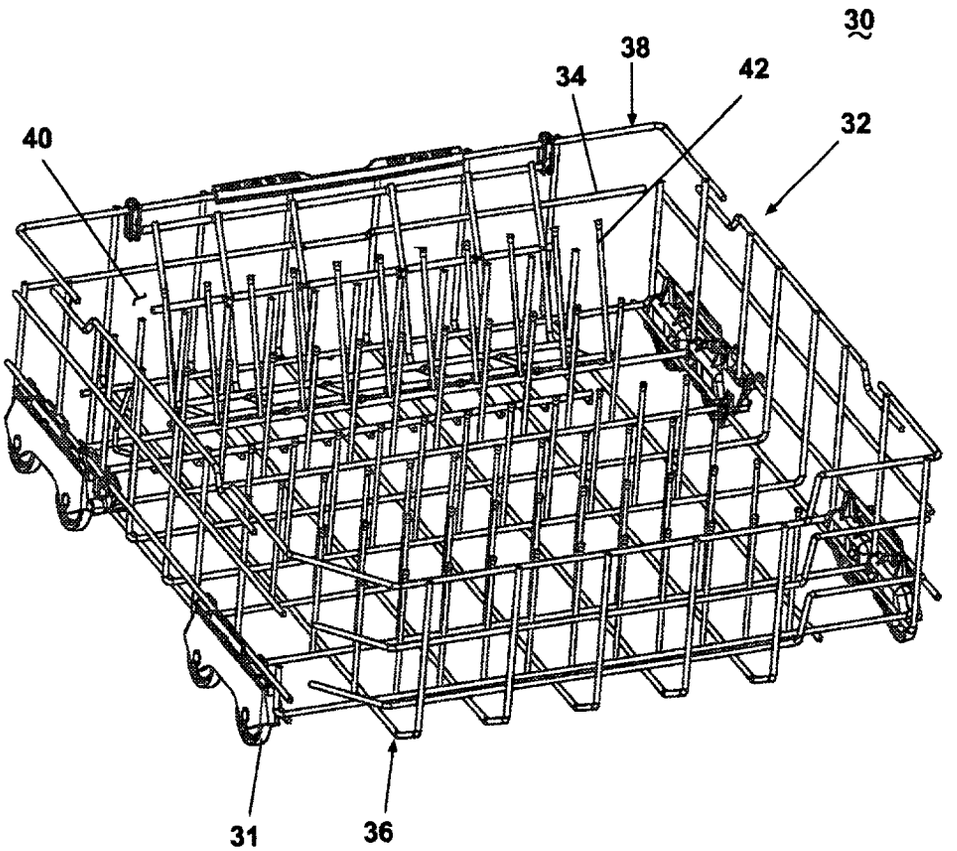

Fig. 2

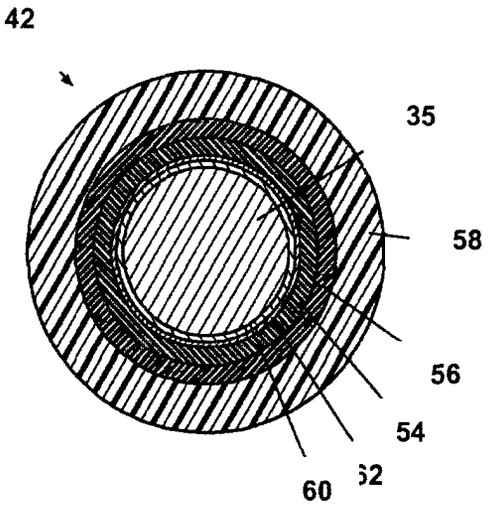

Fig. 3

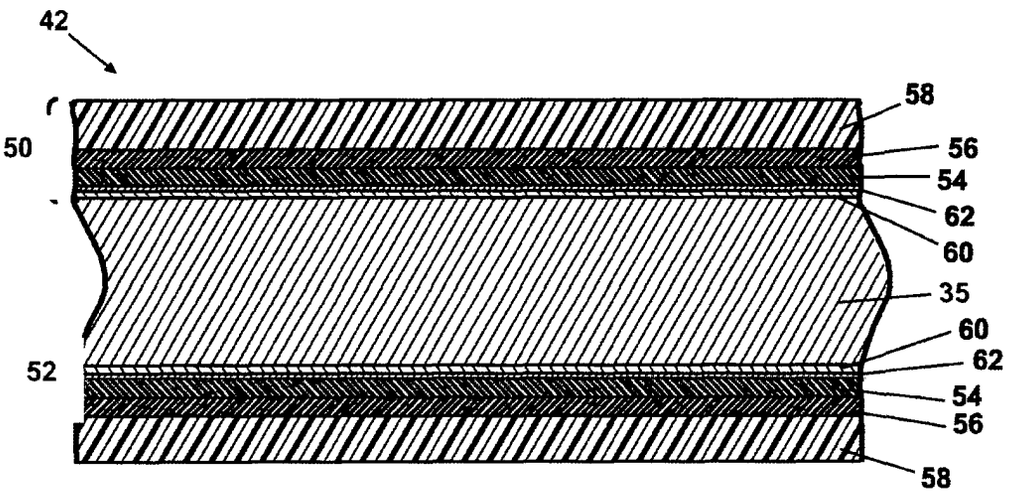

Fig. 4