CLEANER HEAD MEMBER AND METHOD OF MANUFACTURING THE SAME

FIELD OF THE INVENTION

This invention relates to a cleaner head member for a wet cleaning apparatus, and a method of manufacturing the cleaner head member. The invention also relates to a cleaner head assembly comprising the cleaner head member and a cleaner head, to which cleaner head the cleaner head member is attachable and/or detachable. The invention further concerns a wet cleaning apparatus comprising the cleaner head member or the cleaner head assembly.

The cleaner head member and the wet cleaning apparatus can be used, for example, for cleaning a floor, an indoor surface, or a window.

BACKGROUND OF THE INVENTION

Wet cleaning apparatuses, for example wet mopping devices, are known which remove water from a surface to be cleaned. Such wet cleaning apparatuses can also apply cleaning liquid, e.g. water, to the surface to be cleaned, and then remove the liquid, e.g. with a suitable cloth.

Some wet cleaning apparatuses have cleaning liquid delivery functionality for delivering the cleaning liquid to the surface to be cleaned. There can be a risk that delivery of the cleaning liquid is poorly controlled, for example resulting in non-uniform or uneven delivery of the cleaning liquid across the surface to be cleaned, insufficient cleaning liquid being supplied to the surface to be cleaned and/or soaking of the environment with excessive amounts of the cleaning liquid.

Certain wet cleaning apparatuses may include powered pick-up functionality for removing the water from the surface to be cleaned. Wet vacuum cleaners, for instance, may pick up liquid by generating sufficient airspeed (e.g. at least 10 m/s) and/or brushpower to exert enough shear force on liquid droplets to cause them to enter the device. Typical power consumption values for such wet vacuum cleaners are relatively high, for example in the order of several hundred watts.

Further challenges can arise when the wet cleaning apparatus is arranged to deliver cleaning liquid as well as pick up the liquid using suction. Providing both

functionalities can, in at least some designs, risk that the cleaning liquid is suboptimally delivered to the surface to be cleaned and/or used inefficiently.

SUMMARY OF THE INVENTION

The invention is defined by the claims.

According to examples in accordance with an aspect of the invention, there is provided a cleaner head member for a wet cleaning apparatus, the cleaner head member comprising: a support substrate comprising a bottom surface, wherein a cleaning liquid outlet structure, for receiving aqueous cleaning liquid, is provided at the bottom surface; and a cover member arranged over at least the cleaning liquid outlet structure, the cover member being perforated so as to be provided with a plurality of openings that extend through the cover member, the openings being fluidly connected with the cleaning liquid outlet structure to enable delivery of the aqueous cleaning liquid from the cleaning liquid outlet structure through the openings towards a surface to be cleaned.

The openings may be aligned with the cleaning liquid outlet structure.

Alternatively or additionally, the cleaning liquid outlet structure may be recessed into and/or embossed on the bottom surface of the support substrate.

The openings can enable the aqueous cleaning liquid to flow out of space(s) defined between the cleaning liquid outlet structure and the cover member.

The combination of the openings in the cover member and the cleaning liquid outlet structure recessed into and/or embossed on the bottom surface of the support substrate can provide a relatively straightforwardly manufacturable and cost-effective way of controlling delivery of the aqueous cleaning liquid towards the surface to be cleaned.

Each of the openings may extend across the cover member's thickness and open out at opposite sides of the cover member, with a linear central axis of each opening extending across the thickness and passing through an intermediate point surrounded by a wall of the respective opening; the wall being arranged about the linear central axis.

Thus, the openings can be regarded as through-holes that each axially extend through the thickness of the cover member.

The cover member being perforated may mean that the cover member is pierced or punctured to provide the openings.

Such piercing or puncturing can be implemented in any suitable manner, for example using needle(s), e.g. hot needle(s), or laser beam(s).

In embodiments in which the cleaning liquid outlet structure is recessed into the bottom surface of the support substrate, the cleaning liquid outlet structure may comprise a groove defined in and extending across at least part of the bottom surface.

In some embodiments, the cover member comprises a porous layer arranged over the bottom surface. Pores of the porous layer can receive dirty liquid from the surface being cleaned. For example, an underpressure generator included in the wet cleaning apparatus can cause the dirty liquid to be drawn into the pores of the porous layer.

In some embodiments, the porous layer comprises one or more of a woven fabric, a microfiber woven fabric, a mesh, and a perforate membrane.

In some embodiments, the cover member comprises a water-impermeable region, with the water-impermeable region being arranged over the cleaning liquid outlet structure, and the openings being defined in the water-impermeable region. Due to the water-impermeable region covering the cleaning liquid outlet structure, the aqueous cleaning liquid may be exclusively delivered through the cover member via the openings.

Thus, uniformity of distribution of the aqueous cleaning liquid may not be, or at least may be only minimally, affected by permeability of the cover member, e.g. the porous layer thereof.

In some embodiments, the porous layer is provided with a water-impermeable material, with the water-impermeable material defining, at least in part, the water-impermeable region.

In some embodiments, one or more of the openings is/are delimited by a heat-exposed portion of the cover member. Such a heat-exposed portion may, for example, be a melted-then-solidified portion of the cover member.

The heat-exposed portion can assist to reinforce the opening. The heat-exposed portion can, for example, define an annular reinforcement around the opening.

This can assist to reduce the risk of the openings self-closing following perforating, e.g. puncturing, of the cover member, which can be particularly problematic when the openings are relatively small and the cover member is made of a relatively resilient material, such as a textile/fabric.

In some embodiments, the number of openings of the plurality of openings is in the range of 2 to 18, preferably 3 to 10, and most preferably 4 to 10, for example 6. Such a number of openings can assist to ensure that an appropriate amount of the aqueous cleaning liquid is delivered to the surface to be cleaned.

Preferably, the number of openings of the plurality of openings is an even number. The number of openings of the plurality of openings is preferably at least 4.

In the case of an odd number of openings, a higher local pressure at the center opening can disadvantageously result in a more critical cleaning liquid distribution system.

Each of the openings may be dimensioned such that passage of the aqueous cleaning liquid through the openings is restricted due to the surface tension and rheological properties of the aqueous cleaning liquid, e.g. water, while the cleaning liquid outlet structure is being filled with the aqueous cleaning liquid, but with passage of the aqueous cleaning liquid through all of the openings at the same time being permitted once the cleaning liquid outlet structure has been filled with the aqueous cleaning liquid. This may enable relatively uniform cleaning liquid delivery across the cleaning liquid outlet structure.

In some embodiments, the openings each have a diameter in the range of 300 to 700 μm.

Such a diameter can assist the openings to control delivery of the aqueous cleaning liquid therethrough towards the surface to be cleaned.

By making each of the openings sufficiently small, e.g. not more than 700 μm, and having the same, or at least substantially the same, diameter, wetness across the, e.g. the length of the, cleaning liquid outlet structure may be relatively even, and less sensitive to, for instance, detergent(s) included in the aqueous cleaning liquid, noting that such detergent(s) can alter surface energy and rheological properties of the aqueous cleaning liquid.

The term “substantially the same” in the context of the diameters of the openings may mean that the tolerance of the diameters of the openings is preferably at most ±100 μm.

It is also noted that the diameter can be regarded as a hydraulic diameter.

The hydraulic diameter = (4 x the cross-sectional area of the opening through which the cleaning liquid flows) / the wetted perimeter of the cross-sectional area.

It follows from the diameter being a hydraulic diameter that the openings may have any suitable shape when the cover member is viewed in plan, such as square, hexagonal, circular, etc.

The hydraulic diameter may determine the transport resistance and thus pressure drop over the opening.

In some embodiments, the cleaner head member is an elongate cleaner head member, and the cleaning liquid outlet structure is an elongate cleaning liquid outlet structure whose length spans, at least, a majority of the elongate cleaner head member’s lengthways

dimension. Thus, the aqueous cleaning liquid may be delivered across the length of the cleaner head member, thereby providing favorable wetting of the surface to be cleaned by the aqueous cleaning liquid.

In embodiments in which the cleaning liquid outlet structure is an elongate cleaning liquid outlet structure whose length extends across (at least) the majority of the lengthways dimension of the cleaner head member, the water-impermeable region may be an elongate water-impermeable region whose length spans, at least, the majority of the length of the elongate cleaning liquid outlet structure. This can assist to provide favorable distribution of the aqueous cleaning liquid to the surface being cleaned across the length of the cleaner head member.

In some embodiments, the openings span across the cover member.

This may assist distribution of the aqueous cleaning liquid to the surface to be cleaned.

For example, the openings may span across the elongate cleaner head member's lengthways dimension.

In at least some embodiments, the support substrate is a pliable support substrate. Such a pliable support substrate can assist the cleaner head member to follow contours on the surface being cleaned. Alternatively or additionally, the pliability of the pliable support substrate may assist cleaning of the cleaner head member after use, for example involving wringing liquid from the cleaner head member and/or washing the cleaner head member in the user's washing machine.

Such cleaning of the cleaner head member, e.g. when detached from a cleaner head of the wet cleaning apparatus, may assist to remove dirt particles that may build up inside and clog the cleaner head member during use.

In embodiments in which the support substrate is a pliable support substrate, the support substrate may be formed from any suitable pliable material. In some embodiments, the pliable material forming the pliable support substrate comprises a polymeric material and/or elastomeric material.

Particular mention is made of silicone rubber and ethylene-vinyl acetate, in other words a copolymer of ethylene and vinyl acetate, for the pliable material.

In embodiments in which the pliable support substrate is formed from ethylene-vinyl acetate, ethylene may, for example, account for 60 to 90 wt.% of the copolymer.

Other polymeric and/or elastomeric materials, such as a polydiene, e.g. polybutadiene, a thermoplastic elastomer, and so on, can also be contemplated for the pliable material.

Alternatively or additionally, the pliable material can be less than 50 Shore A, preferably less than 20 Shore A, most preferably less than 10 Shore A.

In a non-limiting example, the pliable material is 4 Shore A silicone rubber.

In some embodiments, the pliable support substrate is formed from a closed cell foam material, for example an ethylene-vinyl acetate closed cell foam material.

Such a closed cell foam material may facilitate an efficient (and inexpensive) production/assembly process for fabricating the cleaner head member.

In some embodiments, a dirt inlet structure is defined in and/or arranged on the bottom surface of the support substrate, with the cleaning liquid outlet structure being separated from the dirt inlet structure by region(s) of the support substrate.

By the region(s) of the support substrate separating the dirt inlet structure from the cleaning liquid outlet structure, the risk of cleaning liquid in the cleaning liquid outlet structure being drawn directly into the dirt inlet structure can be lessened or removed. Thus, there may be a greater chance of the cleaning liquid reaching the surface being cleaned. The cleaning liquid may consequently be used more efficiently.

In embodiments in which the support substrate is formed from a closed cell foam material, the closed cell foam material by its nature may prevent transport of cleaning liquid and dirty liquid in the support substrate itself, thus creating a well-defined separation of the cleaning liquid to be delivered to, and the dirty liquid picked up from, the surface to be cleaned.

In embodiments in which the dirt inlet structure is defined in and/or arranged on the surface of the support substrate, the cover member, e.g. the porous layer thereof, may be arranged over the dirt inlet structure.

According to another aspect there is provided a method of manufacturing the cleaner head member according to any of the embodiments described herein, the method comprising: arranging the cover member over at least the cleaning liquid outlet structure of the support substrate; and perforating the cover member to provide the plurality of openings that extend through the cover member.

In some embodiments, the perforating is implemented following the arranging of the cover member over at least the cleaning liquid outlet structure. This ordering can assist to ensure that the openings are correctly positioned over the cleaning liquid outlet structure,

particularly in embodiments in which the cover member is pliable (since the pliability of the cover member may render it more challenging to align the openings already formed in the cover member with the cleaning liquid outlet structure).

The perforating can be implemented in any suitable manner. In some embodiments, the perforating comprises exposing the cover member to a heat source. Such a heat source may result in the openings being delimited by the heat-exposed portion of the cover member.

It is reiterated that the heat-exposed portion can define an annular reinforcement around the opening. Alternatively or additionally, using such a heat source to perforate the cover member can help lessen the risk of fibers of the cover member occluding the opening.

The heat source may comprise at least one selected from laser beam(s) and hot needle(s).

In embodiments in which the laser beam(s) is/are employed to perforate the cover member, an accurate diameter of the openings can be achieved by controlling a diameter of the laser beam at the intended position on the cover member where the respective opening is to be made.

According to yet another aspect there is provided a cleaner head assembly comprising: the cleaner head member according to any of the embodiments described herein; and a cleaner head to which the cleaner head member is attachable and/or detachable.

By the cleaner head member being attachable to the cleaner head, the cleaner head member may, for example, be attached to the cleaner head to replace a previously used cleaner head member.

The capability to detach the cleaner head member from the cleaner head may facilitate cleaning of one or both of the cleaner head member and the cleaner head. Alternatively or additionally, detachment of the cleaner head member may enable replacement of the cleaner head member, for instance when the cleaner head member becomes overly worn.

According to a further aspect there is provided a wet cleaning apparatus comprising: the cleaner head member according to any of the embodiments described herein or the cleaner head assembly according to any of the embodiments described herein; and a cleaning liquid supply for supplying cleaning liquid for delivery towards the surface to be cleaned via the cleaning liquid outlet structure and the plurality of openings.

The cleaning liquid supply may, for example, comprise a cleaning liquid reservoir and a delivery arrangement, e.g. a delivery arrangement comprising a pump, for transporting the aqueous cleaning liquid towards the surface to be cleaned via the cleaning liquid outlet structure and the plurality of openings.

When the delivery arrangement comprises a pump, the cleaning liquid may be actively fed to the cleaning liquid outlet structure. In other embodiments, no pump may be included in the delivery arrangement, such that the cleaning liquid is passively fed to the cleaning liquid outlet structure.

In some embodiments, the wet cleaning apparatus includes an underpressure generator, e.g. a pump, for providing suction to the cleaner head member, e.g. to the dirt inlet structure thereof.

This suction may facilitate removal of dirt, e.g. dirty liquid, from the surface being cleaned using the wet cleaning apparatus.

In such embodiments, the wet cleaning apparatus may be able to supply cleaning liquid to the surface to be cleaned as well as being capable of removing dirt, e.g. dirty liquid, from the surface to be cleaned.

The wet cleaning apparatus may be, for example, a wet mopping device, a window cleaner, a sweeper, or a wet vacuum cleaner, such as a canister-type, stick type, or upright type wet vacuum cleaner. The wet cleaning apparatus may in some examples be a robotic wet vacuum cleaner or a robotic wet mopping device configured to autonomously move the cleaner head member on the surface to be cleaned, such as the surface of a floor.

Particular mention is made of the wet cleaning apparatus being a wet mopping device.

The wet cleaning apparatus may be a battery-powered (or battery-powerable) wet cleaning apparatus, such as a battery-powered (or battery-powerable) wet mopping device, in which the cleaning liquid supply and/or the underpressure generator, e.g. pump, is/are powered (or powerable) by a battery electrically connected (or connectable) thereto.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, and to show more clearly how it may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings, in which:

FIG. 1 provides an exploded view of a cleaner head assembly according to an example;

FIG. 2A provides an exploded view of a cleaner head member according to an example;

FIG. 2B provides a cross-sectional view of the cleaner head member shown in FIG. 2A;

FIG. 3 provides a photomicrograph showing an opening defined in a cover member of a cleaner head member according to an example;

FIG. 4 shows a support substrate of a cleaner head member according to an example;

FIG. 5 provides an exploded view of a cleaner head member according to another example;

FIG. 6 provides a flowchart of a method of manufacturing a cleaner head member according to an example; and

FIG. 7 schematically depicts perforating a cover member of a cleaner head member according to an example using a laser beam.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The invention will be described with reference to the Figures.

It should be understood that the detailed description and specific examples, while indicating exemplary embodiments of the apparatus, systems and methods, are intended for purposes of illustration only and are not intended to limit the scope of the invention. These and other features, aspects, and advantages of the apparatus, systems and methods of the present invention will become better understood from the following description, appended claims, and accompanying drawings. It should be understood that the Figures are merely schematic and are not drawn to scale. It should also be understood that the same reference numerals are used throughout the Figures to indicate the same or similar parts.

Provided is a cleaner head member for a cleaner head of a wet cleaning apparatus, and a method of manufacturing such a cleaner head member. The cleaner head member comprises a support substrate comprising a bottom surface for facing, in use, a surface to be cleaned. A cleaning liquid outlet structure, for receiving aqueous cleaning liquid, is provided at the bottom surface. The cleaner head member further comprises a cover member arranged over at least the cleaning liquid outlet structure. The cover member is

perforated so as to be provided with a plurality of openings that extend through the cover member, through which openings the aqueous cleaning liquid is deliverable from the cleaning liquid outlet structure towards the surface to be cleaned.

Additionally provided is a cleaner head assembly comprising the cleaner head member and the cleaner head.

Further provided is a wet cleaning apparatus comprising the cleaner head member or the cleaner head assembly, and a cleaning liquid supply.

FIG. 1 provides an exploded view of a cleaner head member 100 and a cleaner head 102 according to an example. In some embodiments, the cleaner head member 100 is attachable to and/or detachable from the cleaner head 102.

By the cleaner head member 100 being attachable to the cleaner head 102, the cleaner head member 100 may, for example, be attached to the cleaner head 102 to replace a previously used cleaner head member 100.

The capability to detach the cleaner head member 100 from the cleaner head 102 may facilitate cleaning of one or both of the cleaner head member 100 and the cleaner head 102. Alternatively or additionally, detachment of the cleaner head member 100 may enable replacement of the cleaner head member 100, for instance when the cleaner head member 100 becomes overly worn.

The cleaner head member 100 may be supplied to a user separately from the cleaner head 102 or the wet cleaning apparatus, for example when the cleaner head 102/wet cleaning apparatus is already in the user's possession or the cleaner head 102/wet cleaning apparatus is sourced separately from the cleaner head member 100.

In some embodiments, the cleaner head member 100 and the cleaner head 102 are included in a cleaner head assembly 104. In such embodiments, the cleaner head 102 and the cleaner head member 100 of the cleaner head assembly 104 may be conveniently supplied to the user, for example with the cleaner head member 100 already attached to the cleaner head 102 or with the user being required to assemble the cleaner head assembly 104 by attaching the cleaner head member 100 to the cleaner head 102.

The cleaner head member 100 or the cleaner head assembly 104 may be included in a wet cleaning apparatus that also includes a cleaning liquid supply for supplying aqueous cleaning liquid to the cleaner head member 100.

Such a cleaning liquid supply may, for example, comprise a cleaning liquid reservoir and a delivery arrangement, e.g. a delivery arrangement comprising a pump, for transporting the aqueous cleaning liquid towards the surface being cleaned 105.

In some embodiments, the wet cleaning apparatus includes an underpressure generator, e.g. a pump, for providing suction to the cleaner head member 100.

This suction may facilitate removal of dirt, e.g. dirty liquid, from the surface being cleaned 105 using the wet cleaning apparatus, as will be described in more detail herein below.

In some embodiments, the wet cleaning apparatus includes, together with the cleaner head member 100 or the cleaner head assembly 104, the cleaning liquid supply and the underpressure generator.

Thus, the wet cleaning apparatus may be able to supply aqueous cleaning liquid to the surface being cleaned 105 as well as being capable of removing dirt, e.g. dirty liquid, from the surface being cleaned 105.

In some embodiments, the cleaning liquid supply is configured to provide a continuous delivery of the aqueous cleaning liquid towards the surface to be cleaned 105. Such continuous delivery may, for instance, be provided at the same time as the underpressure generator is supplying suction to the cleaner head member 100.

The cleaning liquid supply and the underpressure generator may, for instance, be configured such that the flow of the aqueous cleaning liquid being delivered is equal to or lower than the flow provided by the underpressure generator.

This may assist to ensure that the surface to be cleaned 105 does not become excessively wet with the aqueous cleaning liquid.

For example, the flow of aqueous cleaning liquid may be in the range of 20 to 100 cm^3/minute, and the flow provided by the underpressure generator may be in the range of 40 to 2000 cm^3/minute, more preferably 80 to 750 cm^3/minute, even more preferably 100 to 300 cm^3/minute, and most preferably 150 to 300 cm^3/minute.

The cleaner head member 100 may have any suitable shape. In some embodiments, such as shown in FIG. 1, the cleaner head member 100 is an elongate cleaner head member 100. Such an elongate cleaner head member 100 can be regarded as having an elongate shape whose lengthways dimension is larger than its width, for instance such that a footprint of the cleaner head member 100 on the surface being cleaned 105 is oblong, or is at least substantially oblong.

Alternatively or additionally, the cleaner head member 100 can be regarded as a flat mop, e.g. a flat mop that is attachable to and/or detachable from a cleaner head 102 in the form of a nozzle.

Such a cleaner head 102, e.g. nozzle, may be of a wet cleaning apparatus or appliance that generates underpressure for suction, and delivers aqueous cleaning liquid, e.g. water, to distribute to the surface to be cleaned 105, for example a floor.

The wet cleaning apparatus may be, for example, a wet mopping device, a window cleaner, a sweeper, or a wet vacuum cleaner, such as a canister-type, stick type, or upright type wet vacuum cleaner. The wet cleaning apparatus may in some examples be a robotic wet vacuum cleaner or a robotic wet mopping device configured to autonomously move the cleaner head member 100 on the surface to be cleaned 105, such as the surface of a floor. Particular mention is made of the wet cleaning apparatus being a wet mopping device.

The wet cleaning apparatus may be a battery-powered (or battery-powerable) wet cleaning apparatus, such as a battery-powered (or battery-powerable) wet mopping device, in which the cleaning liquid supply and/or the underpressure generator, e.g. pump, is/are powered (or powerable) by a battery electrically connected (or connectable) thereto.

In some embodiments, such as shown in FIG. 1, the cleaner head 102 comprises a support element 106, e.g. a rigid support element 106, for supporting the cleaner head member 100 thereon when the cleaner head member 100 is attached to the cleaner head 102.

The support element 106 can be formed from any suitable material. In some embodiments, the support element 106 is formed from a plastic material, e.g. a thermoplastic material.

The support element 106 can be fabricated in any suitable manner. In some embodiments, the support element 106, e.g. the support element 106 formed from the plastic material, is fabricated by a molding process, for instance by injection molding.

In some embodiments, such as shown in FIG. 1, the cleaner head member 100 comprises a connector 108, in other words an interface part, that is connectable to, in other words interfaceable with, a complementary connector 110 of the cleaner head 102.

A cleaning liquid conduit between the cleaner head member 100 and the cleaner head 102 can be provided by the connection between the connector 108 and the complementary connector 110 when the cleaner head member 100 is attached to the cleaner head 102.

Alternatively or additionally, the underpressure generator may be fluidly connected to the cleaner head member 100 via the connector 108 and the complementary connector 110.

The connection between the connector 108 and the complementary connector 110 may, for example, provide a sealed dirt conduit between the cleaner head member 100 and the cleaner head 102 when the cleaner head member 100 is attached to the cleaner head 102.

The sealed conduit may assist to minimize or avoid leakage of the underpressure at the connection between the cleaner head 102 and the cleaner head member 100 defined by the connector 108 and the complementary connector 110.

The complementary connector 110 may be mounted in the cleaner head 102 in any suitable manner. In some embodiments, such as shown in FIG. 1, the complementary connector 110 is mounted in a recess or hole 112 delimited by the support element 106.

The attachment of the cleaner head member 100 to the cleaner head 102 may, for example, be defined by connection of the connector 108 and the complementary connector 110 to each other. In some embodiments, the cleaner head member 100 and/or the cleaner head 102 may include one or more fasteners, provided in addition to the connector 108 and the complementary connector 110, for attaching the cleaner head member 100 to the cleaner head 102.

More generally, and referring now to FIGs. 1, 2A and 2B, the cleaner head member 100 comprises a support substrate 114, which support substrate 114 includes a bottom surface 114A for facing, in use, the surface to be cleaned 105. A cleaning liquid outlet structure 115, for receiving the aqueous cleaning liquid, is provided at, e.g. is recessed into and/or embossed on, the bottom surface 114A of the support substrate 114.

In embodiments in which the cleaning liquid outlet structure 115 is recessed into the bottom surface 114A of the support substrate 114, the cleaning liquid outlet structure 115 may comprise, e.g. be defined by, a groove defined in and extending across at least part of the bottom surface 114A. An example of a cleaning liquid outlet structure 115 in the form of such a groove is shown in FIGs. 1, 2A, 2B and 4.

A width of the groove may be, for example, 1 to 5 mm, such as about 2 mm.

In embodiments in which the cleaner head member 100 is an elongate, e.g. oblong, cleaner head member 100, a length of the groove may span, at least, a majority of the cleaner head member's 100 lengthways dimension.

In more general terms, the cleaning liquid outlet structure 115 may be an elongate cleaning liquid outlet structure 115 whose length spans, at least, a majority of the elongate cleaner head member's 100 lengthways dimension.

In embodiments in which the cleaning liquid outlet structure 115 is embossed on the bottom surface 114A of the support substrate 114, the cleaning liquid outlet structure 115 may comprise, e.g. be defined by, an arrangement of protruding elements protruding from the bottom surface 114A and extending across at least part of the bottom surface 114A, with cleaning liquid path(s) being defined between protruding elements of the arrangement of protruding elements.

It is noted that the cleaning liquid outlet structure 115 can be provided in any suitable manner, for example by pressing a stamp, e.g. a heated stamp, into the material, e.g. closed cell foam material, constituting the support substrate 114 and/or by one or more of laser cutting and milling of the material constituting the support substrate 114. Alternatively or additionally, the cleaning liquid outlet structure 115 may be provided by molding, e.g. injection molding, of the support substrate 114.

Reaction injection molding can, for example, be employed for fabricating the support substrate 114, particularly when the support substrate 114 is formed from a closed cell foam material.

More generally, the support substrate 114 may be a pliable, in other words flexible, support substrate 114.

Such a pliable support substrate 114 can assist the cleaner head member 100 to follow contours on the surface being cleaned 105. Alternatively or additionally, the pliability of the pliable support substrate 114 may assist cleaning of the cleaner head member 100 after use, for example involving wringing liquid from the cleaner head member 100 and/or washing the cleaner head member 100 in the user's washing machine.

Such cleaning of the cleaner head member 100, e.g. when detached from the cleaner head 102, may assist to remove dirt particles that may build up inside and clog the cleaner head member 100 during use.

In embodiments in which the support substrate 114 is a pliable support substrate 114, the support substrate 114 may be formed from any suitable pliable material. In some embodiments, the pliable material forming the pliable support substrate 114 is a polymeric material and/or elastomeric material.

Particular mention is made of silicone rubber and ethylene-vinyl acetate, in other words a copolymer of ethylene and vinyl acetate, for the pliable material.

In embodiments in which the pliable support substrate 114 is formed from ethylene-vinyl acetate, ethylene may, for example, account for 60 to 90 wt.% of the copolymer.

Other polymeric and/or elastomeric materials, such as a polydiene, e.g. polybutadiene, a thermoplastic elastomer, and so on, can also be contemplated for the pliable material.

Alternatively or additionally, the pliable material can be less than 50 Shore A, preferably less than 20 Shore A, most preferably less than 10 Shore A.

In a non-limiting example, the pliable material is 4 Shore A silicone rubber.

In some embodiments, the pliable support substrate 114 is formed from a closed cell foam material, for example an ethylene-vinyl acetate closed cell foam material.

Such a closed cell foam material may facilitate an efficient (and inexpensive) production/assembly process for fabricating the cleaner head member 100.

The connector 108, in other words interface part, may be mounted to the support substrate 114. In at least some embodiments, the connector 108 is permanently affixed to the support substrate 114.

Such mounting and/or permanent affixing of the connector 108 to the support substrate 114 can be implemented in any suitable manner, for example by at least part of the connector 108 being clamped between layers of the cleaner head member 100 and/or by adhering the connector 108 to the support substrate 114, e.g. using adhesive and/or adhesive tape.

In some embodiments, the connector 108 is an integral part of the support substrate 114. In other words, the connector 108 may be formed by the support substrate 114.

This can be implemented, for example, when injection molding is used to fabricate the support substrate 114.

More generally, the cleaner head member 100 comprises a cover member 116 arranged over at least the cleaning liquid outlet structure 115 of the support substrate 114. Thus, the cover member 116 in combination with the cleaning liquid outlet structure 115 may define space(s) in which the aqueous cleaning liquid is receivable.

The support substrate 114 and the cover member 116 can, for example, be regarded as stacked layers of the cleaner head member 100.

The cover member 116 is perforated so as to be provided with a plurality of openings 117 that extend through the cover member 116. The openings 117 may be aligned with the cleaning liquid outlet structure 115 so that the aqueous cleaning liquid is deliverable through the thus aligned openings 117 from the cleaning liquid outlet structure 115 towards the surface to be cleaned 105.

The openings 117 can thus enable the aqueous cleaning liquid to flow out of the space(s) defined by the cleaning liquid outlet structure 115 and the cover member 116.

The openings 117 can be regarded as through-holes, owing to the openings extending through the cover member 116.

In some embodiments, the number of openings 117 of the plurality of openings 117 is in the range of 2 to 18, preferably 3 to 10, and most preferably 4 to 10, for example 6 (as shown in FIGs. 1 and 2A). Such a number of openings 117 may, for example, be combined with uniform spacing between adjacent openings 117 along the cleaning liquid support structure 115. This may assist to ensure uniform delivery of an appropriate amount of the aqueous cleaning liquid to the surface being cleaned 105.

Preferably, the number of openings 117 of the plurality of openings 117 is an even number. The number of openings 117 of the plurality of openings 117 is preferably at least 4.

In the case of an odd number of openings 117, a higher local pressure at the center opening 117 can disadvantageously result in a more critical cleaning liquid distribution system.

Each of the openings 117 may be dimensioned such that passage of the aqueous cleaning liquid through the openings 117 is restricted, due to the surface tension and rheological properties of the aqueous cleaning liquid, while the cleaning liquid outlet structure 115 is being filled with the aqueous cleaning liquid, but with passage of the aqueous cleaning liquid through all of the openings at the same time being permitted once the cleaning liquid outlet structure 115 has been filled with the aqueous cleaning liquid. This may enable relatively uniform cleaning liquid delivery across the cleaning liquid outlet structure 115.

In some embodiments, and referring to FIG. 3, the openings 117 each have a diameter 118 in the range of 300 to 700 μm, for example about 400 μm. Such a diameter 118 can assist the openings 117 to control delivery of the aqueous cleaning liquid therethrough towards the surface to be cleaned 105.

The diameter 118 can be regarded as a hydraulic diameter.

The hydraulic diameter = (4 x the cross-sectional area of the opening 117 through which the cleaning liquid flows) / the wetted perimeter of the cross-sectional area.

By making each of the openings 117 sufficiently small, e.g. not more than 700 μm, and having the same, or at least substantially the same, diameter 118, wetness across the, e.g. the length of the, cleaning liquid outlet structure 115 may be relatively even, and less

sensitive to, for instance, detergent(s) included in the aqueous cleaning liquid, noting that such detergent(s) can alter surface energy and rheological properties of the aqueous cleaning liquid.

The term "substantially the same" in the context of the diameter 118 may mean that the tolerance of the diameters 118 of the openings 117 is preferably at most ±100 μm.

It follows from the diameter being a hydraulic diameter that the openings 117 may have any suitable shape when the cover member 116 is viewed in plan, such as square, hexagonal, circular (as shown in FIG. 3), etc.

The diameter 118 of each of the openings 117 may be determined from microscopic analysis of the cover member 116. A photomicrograph of the cover member 116 of the type shown in FIG. 3 can be analyzed to determine the diameter 118 of each of the openings 117.

In a non-limiting example, there are 6 openings 117 that each have a diameter 118 of 400 μm.

In this illustrative example, the flow rate of the aqueous cleaning liquid through the openings 117 is, for instance, 4 cm^3/minute per opening 117.

In some embodiments, and with continued reference to FIG. 3, one or more of the openings 117 is/are delimited by a heat-exposed portion 119 of the cover member 116. Such a heat-exposed portion 119 may, for example, be a melted-then-solidified portion of the cover member 116.

The heat-exposed portion 119 can assist to reinforce the opening 117. The heat-exposed portion 119 can, in other words, define an annular reinforcement around the opening 117. This can assist to reduce the risk of the openings 117 self-closing following perforating, e.g. puncturing, of the cover member 116, which can be particularly problematic when the openings 117 are relatively small and the cover member 116 is made of a relatively resilient material, such as a textile/fabric.

It is noted that the heat-exposed portion 119 can be provided via the manner in which the cover member 116 is perforated in order to provide the openings 117, for example via laser ablation and/or hot needle perforation.

Methods of manufacturing the cleaner head member 100, including perforating the cover member 116, will be described in more detail herein below.

In embodiments in which the heat-exposed portion 119 is the melted-then-solidified portion of the cover member 116, the cover member 116 implicitly includes a meltable material, such as a thermoplastic material, e.g. polyester.

It is generally noted that the cover member 116 may be formed from any suitable material. In some embodiments, the cover member 116 comprises a plastic material, e.g. the above-mentioned thermoplastic material.

In some embodiments, the cover member 116 comprises at least one selected from polyester and polyamide. Alternatively or additionally, and referring to FIG. 2B, the cover member 116 can comprise a porous layer 120 arranged over the bottom surface 114A of the support substrate 114. Pores of the porous layer 120 can receive dirty liquid from the surface being cleaned 105. For example, the underpressure generator included in the wet cleaning apparatus can cause the dirty liquid to be drawn into the pores of the porous layer 120.

In some embodiments, the porous layer 120 comprises one or more of a woven fabric, e.g. a microfiber woven fabric, a mesh, and a perforate membrane.

Such a mesh, e.g. a monofilament mesh, and/or perforate membrane may represent a relatively straightforward way of providing pores with a well-defined geometry, which may be beneficial for reasons explained below.

In the case of a mesh, e.g. monofilament mesh, the pores may be defined by the manner in which the wires, e.g. polymer wires, of the mesh are woven and/or welded. In such embodiments, the pores may have, for example, a square cross-sectional shape.

For instance, the porous layer 120 may comprise, e.g. be defined by, a plain weave woven mesh or a twill weave woven mesh.

In embodiments in which the porous layer 120 comprises, e.g. is defined by, a woven fabric, e.g. a microfiber woven fabric, the woven fabric can comprise, for example, polyester fibers, polyamide fibers, and combinations of polyester and polyamide fibers.

It is noted that the term “microfiber woven fabric” as used herein may refer to a fabric formed of synthetic fibers, with the fabric being formed of threads whose titre is less than 1 decitex.

It is generally noted that the openings 117 may have a larger diameter 118 than that of the pores of the porous layer 120.

In at least some embodiments, the cover member 116 is a pliable cover member 116.

Such a pliable cover member 116 can assist the cleaner head member 100 to follow contours on the surface being cleaned 105 and/or may assist cleaning of the cleaner head member 100 after use, for example involving wringing of the cleaner head member 100 and/or washing of the cleaner head member 100 in the user's washing machine.

In embodiments in which the support substrate 114 is a pliable support substrate 114, the pliable cover member 116 may be included, together with the pliable support substrate 114, in the cleaner head member 100.

The cover member 116 can be attached to the support substrate 114 in any suitable manner. In at least some embodiments, the cover member 116, e.g. the porous layer 120 thereof, is permanently affixed to the support substrate 114 so as to cover at least the cleaning liquid outlet structure 115.

The affixing of the cover member 116 to the support substrate 114 may comprise watertight attachment of the cover layer 116, e.g. the porous layer 120 thereof, to the support substrate 114.

Such watertight attachment can assist to ensure that the aqueous cleaning liquid is delivered through the openings 117 rather than leaking at an interface between the cover layer 116 and the support substrate 114.

The cover member 116, e.g. the porous layer 120 thereof, may be permanently and/or watertightly affixed to the support substrate 114 in any suitable manner. In some embodiments, the cover member 116, e.g. the porous layer 120 thereof, may be welded to the support substrate 114, e.g. in a process involving melting of one or both of the support substrate 114 and the cover member 116.

Ultrasonic welding may, for example, be used to permenantly affix the support substrate 114 to the cover member 116, e.g. the porous layer 120 thereof. Alternatively or additionally, and referring to FIG. 2B, an adhesive 121 and/or adhesive tape may be employed to affix, e.g. permanently affix, the support substrate 114 to the cover member 116, e.g. to the porous layer 120 thereof.

Whilst liquid permeability of at least part of the support substrate 114, e.g. the porous layer 120 thereof, can facilitate pick-up of dirty liquid from the surface being cleaned 105 (as explained in more detail herein below), such liquid permeability can risk compromising robustness of even distribution of the aqueous cleaning liquid and/or other performance requirements of the cleaner head member 100.

Accordingly in some embodiments, such as shown in FIG. 5, the cover member 116 comprises a water-impermeable region 122, with the water-impermeable region

122 being arranged over the cleaning liquid outlet structure 115, and the openings 117 being defined in the water-impermeable region 122.

Due to the water-impermeable region 122 covering the cleaning liquid outlet structure 115, the aqueous cleaning liquid may be exclusively delivered through the cover member 116 via the openings 117.

Thus, uniformity of distribution of the aqueous cleaning liquid may not be, or at least may be only minimally, affected by permeability of the cover member 116, e.g. the porous layer 120 thereof.

This can, for example, enable a wider range of cleaning liquids with different (e.g. lower) surface energy properties to be used and/or may enable a wider range of materials, e.g. fabrics, meshes, etc., to be included in the cover member 116. Such materials may, for example, be selected according to liquid pick-up-related considerations, rather than aqueous cleaning liquid delivery-related requirements (noting that the openings 117, rather than innate or intrinsic properties/structure of the cover member 116, can ensure that the aqueous cleaning liquid is deliverable in the desired manner through the cover member 116 towards the surface being cleaned 105).

Moreover, by the aqueous cleaning liquid only being delivered via the openings 117, there may be no need to restrict dimensions, e.g. width, of the cleaning liquid outlet structure 115, e.g. a groove thereof, to minimize transport of the aqueous cleaning liquid via the permeable structure of the cover member 116. This, in turn, may facilitate manufacture of the support substrate 114 and assembly of the cleaner head member 100.

Furthermore, inclusion of the water-impermeable region 122 can mean that the size, e.g. diameter, of the openings 117 can be less critical, and may, for instance, be made smaller, since an increase of transport pressure over the openings 117 may no longer result in more transport of water through the material of the cover member 116 itself. This may provide a more robust supply of the aqueous cleaning liquid towards the surface to be cleaned 105.

In embodiments in which the cleaning liquid outlet structure 115 is an elongate cleaning liquid outlet structure 115 whose length extends across (at least) the majority of the lengthways dimension of the cleaner head member 100, the water-impermeable region 122 may be an elongate water-impermeable region 122 whose length spans, at least, the majority of the length of the elongate cleaning liquid outlet structure 115, e.g. groove.

This can assist to provide favorable distribution of the aqueous cleaning liquid to the surface being cleaned 105 across the length of the cleaner head member 100.

It is noted that in embodiments in which the cover member 116 includes the porous layer 120, the porous layer 120 can be provided with a water-impermeable material. In such embodiments, the water-impermeable material can define, at least in part, the water-impermeable region 122.

The water-impermeable region 122, e.g. the water-impermeable material thereof, can be provided in any suitable manner. In some embodiments, the water-impermeable material is in the form of a layer directly applied to the cover member 116, e.g. to the porous layer 120 thereof.

Alternatively the water-impermeable region 122 may be provided by hot stamping the cover member 116, e.g. the porous layer 120 thereof. In other embodiments, the water-impermeable material is in the form of an adhesive tape applied to the cover member 116, e.g. to the porous layer 120 thereof.

The water-impermeable material may be interposed between the support substrate 114 and the cover member 116, e.g. between the support substrate 114 and the porous layer 120. For example, the side of the cover member 116 on which the water-impermeable material is arranged may be directly adjacent, e.g. adhered to, the support substrate 114.

Such an arrangement can assist to minimize side transport of the aqueous cleaning liquid around the water-impermeable material, and thus can help to prevent the aqueous cleaning liquid bypassing the openings 117.

It is noted at this point that the cleaning liquid outlet structure 115 can be supplied with the aqueous cleaning liquid, e.g. via the cleaning liquid supply of the wet cleaning apparatus, in any suitable manner. In some embodiments, and referring to FIGs. 1, 2A, 4 and 5, the support substrate 114 delimits one or more cleaning liquid outlet passages 123 that fluidly couple the cleaning liquid outlet structure 115 with corresponding aperture(s) 124 defined in the connector 108.

Such aperture(s) 124 may, for example, define the connector's 108 contribution to the cleaning liquid conduit provided when the connector 108 and the complementary connector 110 are connected to each other.

In some embodiments, such as shown in FIGs. 1, 2A, 4 and 5, a dirt inlet structure 125A, 125B is defined in and/or arranged on the bottom surface 114A of the

support substrate 114, with the dirt inlet structure 125A, 125B extending across at least part of the bottom surface 114A.

The dirt inlet structure 125A, 125B can receive liquid received by the cover member 116, e.g. received in the pores of the porous layer 120.

In such embodiments, the dirt inlet structure 125A, 125B may, for example, carry the liquid to the sealed dirt conduit provided by the connector 108 of the cleaner head member 100 being connected to the complementary connector 110 of the cleaner head 102.

As best illustrated by the exploded views provided in FIGs. 1, 2A and 5, the cover member 116 may be arranged on the bottom surface 114A of the support substrate 114 to cover the dirt inlet structure 125A, 125B.

In at least some embodiments, the cover member 116, e.g. the porous layer 120 thereof, is permanently affixed to the support substrate 114 so as to cover the dirt inlet structure 125A, 125B, as well as covering the cleaning liquid outlet structure 115.

Thus, the cover member 116 may also assist to retain liquid within the dirt inlet structure 125A, 125B defined in and/or arranged on the bottom surface 114A of the support substrate 114.

In some embodiments, the cover member 116 is sealingly attached to the support substrate 114 around the dirt inlet structure 125A, 125B. This sealing attachment may assist to maintain an underpressure in the dirt inlet structure 125A, 125B with or without the flow being applied by the underpressure generator included in the wet cleaning apparatus.

The sealing attachment can be implemented in any suitable manner, such as by gluing and/or welding the cover member 116, e.g. the porous layer 120 thereof in the case of the embodiment shown in FIGs. 2A and 2B, around the dirt inlet structure 125A, 125B.

In some embodiments, and referring to FIGs. 1, 2A, 4 and 5, the dirt inlet structure 125A, 125B comprises, e.g. is defined by, at least one dirt inlet groove defined in and extending across at least part of the bottom surface 114A.

Alternatively or additionally, the dirt inlet structure 125A, 125B may comprise, e.g. may be defined by, an arrangement of protruding elements protruding from the bottom surface 114A and extending across at least part of the bottom surface 114A, with dirt path(s) being defined between protruding elements of the arrangement of protruding elements.

The dirt inlet structure 125A, 125B can be provided in any suitable manner, for example by pressing a stamp, e.g. a heated stamp, into the material, e.g. closed cell foam material, constituting the support substrate 114 and/or by one or more of laser cutting and

milling of the material of the support substrate 114. Alternatively or additionally, the dirt inlet structure 125A, 125B may be provided by molding, e.g. injection molding, such as reactive injection molding, of the support substrate 114.

In some embodiments, and referring to FIGs. 1, 2A, 4 and 5, the support substrate 114 delimits one or more dirt inlet passages 127A, 127B that fluidly couple the dirt inlet structure 125A, 125B with corresponding (further) aperture(s) 128A, 128B defined in the connector 108.

It is noted that such (further) aperture(s) 128A, 128B may define the connector's 108 contribution to the sealed dirt conduit provided when the connector 108 and the complementary connector 110 are connected to each other.

A bulk of the support substrate 114 may provide a flow barrier for liquid so that the liquid from the surface being cleaned 105 and the cleaning liquid delivered towards the surface being cleaned 105 respectively follow the flow paths defined by the dirt inlet structure 125A, 125B and the cleaning liquid outlet structure 115.

In some embodiments, and as best shown in FIGs. 1 and 4, the cleaning liquid outlet structure 115 is separated from the dirt inlet structure 125A, 125B by region(s) 129A, 129B of the support substrate 114.

By the region(s) 129A, 129B of the support substrate 114 separating the dirt inlet structure 125A, 125B from the cleaning liquid outlet structure 115, the risk of cleaning liquid in the cleaning liquid outlet structure 115 being drawn directly into the dirt inlet structure 125A, 125B can be lessened or removed. Thus, there may be a greater chance of the cleaning liquid reaching the surface being cleaned 105. The cleaning liquid may consequently be used more efficiently.

The dirt inlet structure 125A, 125B and the cleaning liquid outlet structure 115 can be tuned for equal fluid distribution in/on the support substrate 114 that is connected, e.g. directly connected, to the connector 108.

The clean and dirty liquid distribution can be tuned by balancing the resistance of the cover member 116, e.g. the porous layer 120, e.g. via selection of the material(s) and its surface area. Alternatively or additionally, different shapes and patterns of the dirt inlet structure 125A, 125B, e.g. groove(s), and the cleaning liquid outlet structure 115, e.g. groove(s), may be employed.

In some embodiments, the cleaning liquid conduit and the sealed dirt conduit between the cleaner head member 100 and the cleaner head 102 are provided by the

connection between the connector 108 and the complementary connector 110 when the cleaner head member 100 is attached to the cleaner head 102.

The connector 108 may thus provide an integrated connector 108 for coupling the wet cleaning apparatus's underpressure generator and cleaning liquid supply respectively to the dirt inlet structure 125A, 125B and the cleaning liquid outlet structure 115 of the cleaner head member 100.

In some embodiments, and as best shown in FIGs. 1 and 4, the dirt inlet structure 125A, 125B comprises a first dirt inlet structure 125A and a second dirt inlet structure 125B that are arranged to receive liquid from different portions of the cover member 116, e.g. the porous layer 120 thereof.

In such embodiments, the first dirt inlet structure 125A may extend along at least part of the cleaner head member's 100 lengthways dimension, and the second dirt inlet structure 125B may also extend along at least part of the cleaner head member's 100 lengthways dimension but with the first dirt inlet structure 125A being separated from the second dirt inlet structure 125B across the width of the support substrate 114.

In embodiments, such as shown in FIGs. 1 and 4, in which the dirt inlet structure 125A, 125B comprises the first dirt inlet structure 125A and the second dirt inlet structure 125B, the cleaning liquid outlet structure 115 may be arranged between the first dirt inlet structure 125A and the second dirt inlet structure 125B.

This arrangement may provide efficient cleaning liquid delivery to and liquid pick-up from the surface being cleaned 105.

Referring now to the flowchart provided in FIG. 6, the present disclosure further provides a method 140 of manufacturing a cleaner head member 100 according to any of the embodiments described herein. The method 140 comprises arranging 142 the cover member 116 over at least the cleaning liquid outlet structure 115 of the support substrate 114, and perforating 144 the cover member 116 to provide the plurality of openings 117 in the cover member 116.

In some embodiments, such as shown in FIG. 6, the perforating 144 is implemented following the arranging of the cover member 116 over at least the cleaning liquid outlet structure 115. This ordering can assist to ensure that the openings 117 are correctly positioned over the cleaning liquid support structure 115, particularly in embodiments in which the cover member 116 is pliable (since the pliability of the cover member 116 may render it more challenging to align the openings 117 already formed in the cover member 116 with the cleaning liquid support structure 115).

In embodiments, such as shown in FIG. 2B and 7, in which the cleaner head member 100 further comprises a surface interaction layer 150 for contacting the surface to be cleaned 105, it may be challenging to perforate 144 the porous layer 120 to provide the openings 117 in the porous layer 120, arrange the thus perforated porous layer 120 on the surface interaction layer 150, and then arrange the perforated porous layer-surface interaction layer assembly 120, 150 on the support substrate 114.

Accordingly, the perforating 144 can include, when the cover member 116 includes the porous layer 120 and the surface interaction layer 150, perforating the porous layer 120 and the surface interaction layer 150 while the porous layer 120 and the surface interaction layer 150 are both arranged on the support substrate 114. A non-limiting example of the latter is schematically depicted in FIG. 7.

It is generally noted that in embodiments in which the cleaner head member 100 includes the surface interaction layer 150 and the porous layer 120, the surface interaction layer 150 can be arranged on the porous layer 120 in any suitable manner. For example, the surface interaction layer 150 can be attached to the porous layer 120 via sewing and/or using an adhesive.

Once attached to each other, e.g. via sewing and/or adhesive, the porous layer-surface interaction layer assembly 120, 150 may be arranged on, e.g. affixed to, the support substrate 114, for example via adhesive 121 between the porous layer 120 and the support substrate 114.

The perforating 144 can be implemented in any suitable manner. In some embodiments, such as shown in FIG. 7, the perforating 144 comprises exposing the cover member 116 to a heat source. Such a heat source may result in the openings 117 being delimited by the heat-exposed portion 119 of the cover member 116.

It is reiterated that the heat-exposed portion 119 can define an annular reinforcement around the opening 117. Alternatively or additionally, using such a heat source to perforate the cover member 116 can help lessen the risk of fibers of the cover member 116 occluding the opening 117.

The heat source may comprise at least one selected from laser beam(s) 152 (as shown in FIG. 7) and hot needle(s).

In embodiments in which the laser beam(s) 152 is/are employed to perforate 144 the cover member 116, an accurate diameter of the openings 117 can be achieved by controlling a diameter of the laser beam at the intended position on the cover member 116 where the respective opening 117 is to be made.

To this end, a first laser beam 152A may be focussed by optics 154, e.g. lens(es), to provide a second, focussed laser beam 152B whose diameter controls the diameter of the opening 117.

The beam focus or waist of the focussed laser beam 152B refers to a smallest diameter of the focussed laser beam 152B at its focal point.

In some embodiments, such as shown in FIG. 7, the perforating 144 comprises defining an opening 117 whose diameter is larger than the waist of the focussed laser beam 152B.

If the focus depth of the focussed laser beam 152B is relatively short, the focal point may be positioned in front of (above in the view provided in FIG. 7) the cover member 116 or porous layer 120.

This may result in a lower laser intensity in the cover member 116 closer to the support substrate 114, e.g. a lower laser intensity in the porous layer 120, where the opening 117 may be required, than in the surface interaction layer 150.

When pulsing the laser, the focussed laser beam 152B may relatively easily penetrate the surface interaction layer 150, and can accurately shape the opening 127, depending on the diameter of the focussed beam 152B at the level of the porous layer 120.

Since the beam 152B may be diverging at the level of the support substrate 114, damage to a surface of the support substrate 114 where the cleaning liquid outlet structure 115 is provided may be minimized.

In order to promote formation of the heat-exposed portion 119, e.g. the melted-then-solidified portion 119, the power of the laser may be selected to be relatively small (e.g. resulting in a longer pulse duration). Thus, evaporation of the cover member 116 around the opening 117 may be minimized.

A jig included in the laser ablation/drilling apparatus may be used to align the pre-formed cover member-support substrate arrangement 116, 114 with respect to the laser beam(s) 152.

It is noted that in embodiments in which the cleaner head member 100 includes the surface interaction layer 150 and the porous layer 120, the surface interaction layer 150 may be more water permeable than the porous layer 120.

Regarding the porous layer 120 that can be included in the cover member 116, it is noted that the porous layer 120 may assist to maintain an underpressure in the cleaner head member 100, with or without a flow being applied by the underpressure generator included in the wet cleaning apparatus.

When the porous layer 120 is dry, the porous layer 120 may be regarded as being in an "air transport state" in which air is transported through each of the dry pores of the porous layer 120. A "liquid transport state" corresponds to liquid, e.g. water, being transported through the (wetted) pores of the porous layer 120. When there is no longer a feed of liquid to the pores, a "fluid block state" may be adopted. The "fluid block state" corresponds to the state at which the surface tension of the (residual) liquid retained in the wetted pores of the porous layer 120 prevents fluid transport through the pores. In the latter state, a surface or barrier is created at the boundary between air and liquid, e.g. water. This barrier can assist to maintain the underpressure between the porous layer 120 and the underpressure generator. The pressure needed to "break" this barrier can be termed a "breaking pressure".

In some embodiments, pores of the porous layer 120 extend across the porous layer's 120 thickness and open out at opposite sides of the porous layer 120, with a linear central axis of each pore extending across the thickness and passing through an intermediate point surrounded by a pore wall of the respective pore; the pore wall being arranged about the linear central axis. In such embodiments, each pore can be regarded as a through-hole that axially extends through the thickness of the porous layer 120.

A path of least resistance to fluid flow across the porous layer 120 may be defined along the linear central axes of the pores.

Pores of the porous layer 120, whose linear central axis extends across the porous layer's 120 thickness and passes through an intermediate point surrounded by a pore wall of the respective pore, are considered to be better defined than, for example, pores defined between fibers of a woven fabric.

In particular, the pores of the porous layer 120 may have a pore size distribution that can be selected to be separate from, in other words not overlapping with, a pore size distribution of a further porous layer, e.g. the surface interaction layer 150, arranged on the porous layer 120. In particular, the pore size distribution of the porous layer 120 may be shifted to larger pore sizes than the pore size distribution of the further porous layer.

This may mean that dirt particles that are sufficiently small to initially pass through the further porous layer also pass through the porous layer 120 when the porous layer 120 and the further porous layer are subjected to the underpressure generated by the wet cleaning apparatus's underpressure generator. This may make the porous layer 120 less liable to be clogged by such dirt particles during use.

Such pores can be defined in any suitable manner, for example by laser ablation of a polymeric membrane, or by a woven structure of a mesh, e.g. a monofilament mesh.

In some embodiments, each pore of the porous layer 120 has a polygonal, e.g. square, or circular cross-sectional shape perpendicular to the linear central axis. Such a polygonal, e.g. square, or circular cross-sectional shape perpendicular to the linear central axis may mean that the pore wall provides a consistent surface, in particular a relatively well-defined rim between a surface of the pore wall and exterior surface(s) of one or both sides of the porous layer 120. This can assist to increase the breaking pressure.

The rim between a surface of the pore wall and an exterior surface of the porous layer 120 may, for example, have a radius of curvature of 0.1 µm to 3 µm.

Such a radius of curvature, which may be significantly smaller than the pore radius, may assist to prevent the size of the liquid-air interface/surface from growing when pressure is applied. This may prevent the increase in force on the surface (force being equal to pressure multiplied by area), hence prevents the surface's edge from being overloaded sooner, thereby keeping the surface from collapsing/"exploding".

It is noted that such well-defined pores of the porous layer 120 contrast with the pores defined between fibers of a woven fabric in which a range of contact angles are effectively provided around the surfaces delimiting a given pore. The shapes of the upstream and downstream openings of such a woven fabric pore are also not as well-defined as the upstream and downstream rims of the porous layer. This means that in the case of a pore of a woven fabric, there may always be a place in the pore where the contact angle reaches its limit so that the liquid barrier can no longer maintain its position. The resultant barrier movement may enlarge the surface area on which the pressure acts; the total force on the barrier increasing, making it harder for the rest of the barrier to maintain its position, with further movement resulting, and so on. This issue may be addressed by the well-defined pore geometry of each of the pores of the porous layer 120 according to embodiments of the present disclosure.

In summary, a contact angle between liquid and the surface of the porous layer 120 may always be present; an increase in pressure may move an edge of the barrier to a new position of equilibrium; if this shifting occurs while the barrier remains relatively small, higher breaking pressures can be obtained; if the shifting occurs while significantly increasing the surface area of the barrier, the breaking pressure may be lower.

In some embodiments, the thickness of the porous layer 120 is less than 200 µm, preferably less than 100 µm. Such a maximum thickness may contribute to minimizing of flow resistance through the porous layer 120.

The thickness of the porous layer 120 can be determined by using a precision gauge and two ground metal plates (with the upper plate by which the normal pressure is applied being 70 mm x 30 mm, and the lower plate on which the sample of the porous layer 120 is supported having a larger area than the 70 mm x 30 mm surface of the upper plate for ease of alignment) for receiving the porous layer 120 therebetween. The arrangement is configured to apply a pressure normal to the sample of the porous layer 120 (70 mm x 30 mm) of 864.2 N/m^2. The relevant measurement parameters are provided in Table 1:

Metal plate parameters	Length	70 mm	Area of sample	2100 mm^2
	Width	30 mm	Total mass	185 g
	mass	85 g	Total force	1.81 N
	Fn (gauge force)	100 g	Pressure	864.2 N/m^2

Table 1

In some embodiments, the cover member 116 comprises the further porous layer, e.g. the surface interaction layer 150, for contacting the surface to be cleaned 105, with the porous layer 120 being interposed between the further porous layer and the support substrate 114.

Liquid received from the surface being cleaned 105 may be transported through pores of the further porous layer to the pores of the porous layer 120.

The further porous layer may be arranged on the porous layer 120 in any suitable manner. In some embodiments, the further porous layer is detachable from the porous layer 120, for example to facilitate cleaning of one or both of the porous layer 120 and the further porous layer. Alternatively or additionally, detachment of the further porous layer may enable the further porous layer to be replaced without having to replace the porous layer 120 at the same time.

In some embodiments, the further porous layer, e.g. the surface interaction layer 150, is in the form of a disposable, e.g. single-use, cloth or wipe.

The further porous layer, e.g. the surface interaction layer 150, can be formed from any suitable material, such as viscose, polyester or polyvinylalcohol.

Preferably the material forming the further porous layer, e.g. the surface interaction layer 150, is biodegradable and/or sustainable.

The further porous material, e.g. the above-mentioned cloth or wipe, can be fixed to the cleaner head member 100, the cleaner head 102 and/or the support substrate 114 in any suitable manner, for example via hooks-loops fasteners and/or via flexible grippers.

In embodiments in which the flexible grippers are employed, such flexible grippers may, for example, be integrated into the pliable material of the support substrate 114.

In other embodiments, the porous layer 120 and the further porous layer are permanently affixed to each other, for example via sewing, welding, e.g. ultrasonic welding, and/or via an adhesive.

Such permanent attachment of the porous layer 120 and the further porous layer to each other may make manufacture of the cleaner head member 100 simpler and less expensive.

In some embodiments, the further porous layer comprises one or more woven fabric layers, e.g. one or more microfiber fabric layers.

The woven fabric layer(s) can comprise, for example, polyester fibers, polyamide fibers, and combinations of polyester and polyamide fibers.

The further porous layer may, more generally, be formed from a polyester and/or a polyamide.

In some embodiments, a pore size distribution of the porous layer 120 spans a range of pore sizes whose smallest pore size is larger than a largest pore size of a range of pore sizes spanned by the further porous layer.

This may mean that dirt particles passing through the further porous layer may also pass through the porous layer 120 when the porous layer 120 and the further porous layer are subjected to the underpressure generated by the wet cleaning apparatus's underpressure generator.

This may make the porous layer 120 less liable to be clogged by such dirt particles during use because dirt particles that are sufficiently small to initially pass through the further porous layer also pass through the porous layer 120.

In some embodiments, the pores of the porous layer 120 are exclusively arranged in a region of the porous layer 120 that remains in contact with the further porous layer.

The maintaining of contact between the further porous layer and the porous layer 120 may mean that any "broken" pores in the porous layer 120 may be kept supplied

with liquid from the further porous layer, and thereby "repaired". This can assist maintenance of the underpressure between the underpressure generator and the porous layer 120.

Alternatively or additionally, the further porous layer may have a porous structure configured to enable lateral fluid transport in a first direction within the further porous layer as well as fluid transport in a second direction across a thickness of the further porous layer towards the porous layer 120. Such a porous structure may be provided, for example, by the further porous layer comprising, e.g. being defined by, the one or more woven fabric layers.

The lateral fluid transport provided in the further porous layer can assist to keep the porous layer 120 supplied with liquid, thereby helping to repair broken pores of the porous layer 120.

ASTM F316 – 03, 2019, Test A provides a bubble point pressure measurement. Whilst this standard method was developed for nonfibrous membrane filters, the procedure can be replicated for the porous layer 120, as well as for the further porous layer when present.

The bubble point test for determining the limiting pore diameter, in other words maximum pore size, is, in summary, performed by prewetting a sample of the porous layer 120, increasing the pressure of gas upstream of the porous layer 120 at a predetermined rate, and watching for gas bubbles downstream to indicate the passage of gas through the pores, e.g. maximum diameter pores, of the porous layer 120.

In common with the membrane filters described in ASTM F316 – 03, 2019, Test A, the porous layer 120 may (at least to an approximation depending on the pore structure/type of porous layer 120) have discrete pores extending from one side of the porous layer 120 to the other, similarly to capillary tubes. The bubble point test is based on the principle that a wetting liquid is held in these capillary pores by capillary attraction and surface tension, and the minimum pressure required to force liquid from these pores is a function of pore diameter. The pressure at which a steady stream of bubbles appears in this test is termed the "bubble point pressure".

It is noted that ASTM F316 – 03, 2019, Test A is based on an approximation of the pores as capillary pores having circular cross-sections, and hence the limiting pore diameter should be regarded as merely an empirical estimate of the maximum pore diameter based on this premise.

The testing apparatus mandated in ASTM F316 – 03, 2019, Test A is replicated, as is the test procedure.

1. The sample of porous layer 120 (2 inch (50.8 mm) diameter, held in a circular holder such as to have an open/active area having a diameter of 47 mm), is wetted completely by floating it on a pool of the liquid (noting that a vacuum chamber may be used to assist in wetting the sample, if necessary). For water-wettable samples, the sample is placed in water and soaked fully.

2. The wet sample of porous layer 120 is placed in the filter holder of the test apparatus.

3. A fine (100 by 100) mesh is placed onto the sample of porous layer 120; the fine mesh being a first part of the 2-ply construction mandated by the standard.

4. The second part of the 2-ply construction, in the form of a perforated metal component to add rigidity, is placed on the fine mesh.

5. A support ring is placed onto the stack and secured in place using bolts. A slight gas pressure can be applied at this point to eliminate possible liquid backflow.

6. The perforated metal component is covered with 2 to 3 mm of test liquid (Type IV water as mandated by the standard when the sample is wettable with water).

7. The gas pressure is then raised and the lowest pressure at which a steady stream of bubbles rises from the central area of the reservoir is recorded (see Fig. 5 of ASTM F316 – 03, 2019, Test A; noting that bubbles observed at the edge of the reservoir are neglected for the bubble point determination).

It is suitable to first raise the pressure relatively quickly, e.g. at about 200 Pa/second, to roughly determine the bubble point. Pressure can then be relieved from the sample to allow the water to run back into the sample. The pressure is then raised to roughly 80% of the expected pressure value, maintained at the 80% level for about 15 seconds (to ensure all “free” water is pressed out of the sample), and then raised again at a lower rate of ≤ 50 Pa/second until the constant flow of bubbles was observed.

The limiting pore diameter, d, is then determined from the recorded bubble point pressure, p, using equation 1 of ASTM F316 – 03, 2019, Test A: $d = C\gamma/p$, where γ is the surface tension in mM/m (72.75 for distilled water at 20°C), and C is 2860 when p is in Pa.

In some embodiments, the porous layer 120 has a limiting pore diameter, as measured using ASTM F316 – 03, 2019, Test A, that is less than or equal to 105 µm. The 105 µm upper limit for the limiting pore diameter, equivalent to a minimum bubble point pressure of 2000 Pa, may assist to ensure that sufficient underpressure is maintainable by the porous layer 120.

Alternatively or additionally, the porous layer 120 has a limiting pore diameter, as measured using ASTM F316 – 03, 2019, Test A, that is greater than or equal to 6 µm. It has been found empirically that a limiting pore diameter equal to or greater than 6 µm may assist to maintain a relatively large underpressure whilst ensuring that pores still enable efficient liquid transport therethrough. The latter may also be assisted by minimizing the thickness of the porous layer 120.

In some embodiments, the porous layer 120 has a limiting pore diameter, as measured using ASTM F316 – 03, 2019, Test A, that is greater than or equal to 8 µm, most preferably greater than or equal to 11 µm.

In some embodiments, the limiting pore diameter of the porous layer 120 as measured using ASTM F316 – 03, 2019, Test A is 11 to 15 µm.

It has been observed that "self-repair" of "broken" pores of the porous layer 120, e.g. when the porous layer 120 is employed together with the above-mentioned further porous layer, e.g. a further porous layer made of a woven fabric, may be enhanced when the limiting pore diameter of the porous layer 120 is 11 to 15 µm.

In some embodiments, the further porous layer has a limiting pore diameter, as measured using ASTM F316 – 03, 2019, Test A, equal to or less than 105 µm and/or equal to or greater than 15 µm.

It has been found empirically that a limiting pore diameter of the further porous layer being equal to or greater than 15 µm may assist to maintain a relatively large underpressure whilst ensuring that pores are sufficiently large for efficient liquid transport through the further porous layer.

Equivalently, a bubble point pressure of the further porous layer as measured using ASTM F316 – 03, 2019, Test A may be equal to or less than 13500 Pa.

In some embodiments, a limiting pore diameter of the further porous layer as measured using ASTM F316 – 03, 2019, Test A is equal to or less than 105 µm. This upper limit for the limiting pore diameter assists to ensure that sufficient underpressure is maintainable by the further porous layer.

Equivalently, a bubble point pressure of the further porous layer as measured using ASTM F316 – 03, 2019, Test A may be equal to or greater than 2000 Pa. Preferably, the bubble point pressure of the further porous layer is 7000 Pa to 9000 Pa.

More generally, the underpressure generator of the wet cleaning apparatus may subject the porous layer 120 to the underpressure, preferably by being configured to generate a flow through the porous layer 120 that is at most 2000 cm^3/minute.

In some embodiments, the underpressure generator is configured to supply said suction by providing a flow through the porous layer 120 in the range of 15 to 2000 cm^3/minute, more preferably 80 to 750 cm^3/minute, even more preferably 100 to 300 cm^3/minute, and most preferably 150 to 300 cm^3/minute.

Such a flow, i.e. flow rate, may capitalise on the underpressure-maintaining capability of the porous layer 120, and may ensure sufficient liquid pick-up whilst limiting energy consumption.

The underpressure generator may be configured to provide a pressure difference between an inside of the wet cleaning apparatus and atmospheric pressure for drawing fluid through the porous layer 120, with the pressure difference being in a range of 2000 Pa to 15000 Pa, preferably 2000 Pa to 13500 Pa.

The pressure difference can be directly and positively verified in a given wet cleaning apparatus by, for example, drilling a hole in a tube of the wet cleaning apparatus that fluidly connects the underpressure generator and pores of the porous layer 120 and using the hole to couple to a pneumatic pressure sensor itself having a tube with a membrane covering an end thereof; the sensor being thus connected using an airtight connection. The sensor may be arranged to avoid disturbing the flow, hence the skilled person will arrange the sensor to avoid, for instance, creating a bypass flow. No flow may be towards or from the sensor: only pressure is transmitted. In this way, the flow of the appliance may never be compromised (hence may remain at the set level in spite of the sensor installation).

The pressure sensor is connected between the porous layer 120 and the underpressure generator and as close to the porous layer 120 as possible, to minimise the influence of other factors, such as flow resistance etc., on the sensed pressure difference.

The sensing element/ membrane of the pressure sensor/gauge is ideally arranged/positioned in the pressure sensor so that the sensing element can be placed directly (without the requirement for connecting tubes) in the tube, or in a cavity behind the porous layer 120.

By positioning the membrane of the pressure sensor, in other words membrane pressure gauge, with the membrane positioned at, in other words in line with, the wall of the tube (or exposed to the cavity), measurement errors may be minimized, as will be appreciated by a person skilled in the art.

It is noted that air bubbles inside narrow tubes may generate resistance (capillary/surface tension effects), and hence may influence the measurement. Hence the

skilled person will further appreciate that care is also to be taken that air bubbles (water-air surfaces) do not unduly influence the pressure difference measurement.

It is further noted that a column of water present between the pressure sensor and the porous layer 120 should be deducted from the measurement result (if such a column of water is present during the measurement), to compensate for the static pressure generated by the column of water.

Once the pressure sensor is arranged as described above, it may be ascertained that maintenance of the underpressure is due to the porous layer 120, and the further porous layer when present, and not some other element, such as a valve. Any such element that influences the underpressure that is presented to the porous layer 120 should be rendered inoperable for the purpose of performing the measurement.

Component(s) that dispense cleaning liquid (should the wet cleaning apparatus be configured to deliver cleaning liquid) is/are disengaged when performing the pressure difference measurement.

The wet cleaning apparatus is turned on (in the desired setting), so that the pick-up system comprising the underpressure generator is activated. Recording of data from the pressure sensor is started.

The pick-up area of the cleaner head member 100 is suspended in a layer of water, at max. 5 mm depth.

The pick-up area is then lifted from the water without tilting it in any way (so that the cleaner head member 100 remains in a cleaning position, as if it were positioned to clean the floor), so that the water is no longer touching the porous layer 120 or the further porous layer, when present. At this point, “free water” will be removed from the porous layer 120 (and the further porous layer, when present), all pores will go into their “blocked state”, and the breaking pressure is determinable. An equilibrium is established in an end regime in which the applied flow results in an underpressure which causes no more fluid blocks to break.

The breaking pressure obtained from this measurement result, at the end regime, is the “pressure difference between the inside of the wet cleaning apparatus and atmospheric pressure for drawing fluid through the porous layer 120.” It is verified from the measurement result whether or not the 2000 Pa to 15000 Pa range, or the 2000 Pa to 13500 Pa preferred range, is satisfied.

The underpressure generator may, for example, comprise a positive displacement pump, such as a peristaltic pump.

Such a positive displacement pump can assist to maintain the underpressure after the underpressure generator has been deactivated, e.g. switched off, because the pump design inherently restricts backflow from the pump outlet. This, in turn, may alleviate problematic liquid release from the porous layer 120, for instance following cleaning of the surface to be cleaned 105 and/or during stowing of the wet cleaning apparatus in a storage area after use.

The wet cleaning apparatus may include a dirty liquid collection tank. In such embodiments, the underpressure generator may be arranged to draw liquid through the porous layer 120 and to the dirty liquid collection tank, e.g. via the dirt inlet structure 125A, 125B.

Variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

If the term "adapted to" is used in the claims or description, it is noted the term "adapted to" is intended to be equivalent to the term "configured to".

Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. A cleaner head member (100) for a wet cleaning apparatus, the cleaner head member comprising:

a support substrate (114) comprising a bottom surface (114A), wherein a cleaning liquid outlet structure (115), for receiving aqueous cleaning liquid, is provided at the bottom surface; and

a cover member (116) arranged over at least the cleaning liquid outlet structure, the cover member being perforated so as to be provided with a plurality of openings (117) that extend through the cover member, the openings being in fluid connection with the cleaning liquid outlet structure to enable delivery of the aqueous cleaning liquid from the cleaning liquid outlet structure through the openings towards a surface to be cleaned.

2. The cleaner head member (100) according to claim 1, wherein the cover member (116) comprises a water-impermeable region (122), the water-impermeable region being arranged over the cleaning liquid outlet structure (115), the openings (117) being defined in the water-impermeable region.

3. The cleaner head member (100) according to claim 1 or claim 2, wherein the cover member (116) comprises a porous layer (120) arranged over the bottom surface (114A); optionally wherein the porous layer comprises one or more of a woven fabric, a mesh, and a perforate membrane.

4. The cleaner head member (100) according to claim 3 as according to claim 2, wherein the porous layer (120) is provided with a water-impermeable material, the water-impermeable material defining, at least in part, the water-impermeable region (122).

5. The cleaner head member (100) according to any one of claims 1 to 4, wherein one or more of the openings (117) is/are delimited by a heat-exposed portion (119) of the cover member (116).

6. The cleaner head member (100) according to any one of claims 1 to 5, wherein the openings (117) span across the cover member.

7. The cleaner head member (100) according to any one of claims 1 to 6, wherein each of the plurality of openings (117) is dimensioned such that passage of the aqueous cleaning liquid through the openings is restricted while the cleaning liquid outlet structure (115) is being filled with the aqueous cleaning liquid, but with passage of the aqueous cleaning liquid through all of the openings at the same time being permitted once the cleaning liquid outlet structure has been filled with the aqueous cleaning liquid.

8. The cleaner head member (100) according to any one of claims 1 to 7, wherein the cleaner head member is an elongate cleaner head member, and the cleaning liquid outlet structure (115) is an elongate cleaning liquid outlet structure whose length spans, at least, a majority of the elongate cleaner head member's lengthways dimension.

9. The cleaner head member (100) according to claim 8 as according to claim 2 or claim 4, wherein the water-impermeable region (122) is an elongate water-impermeable region whose length spans, at least, a majority of the length of the elongate cleaning liquid outlet structure (115).

10. The cleaner head member (100) according to any one of claims 1 to 9, wherein the support substrate (114) is a pliable support substrate; optionally wherein the support substrate is formed from a closed cell foam material.

11. A method (140) of manufacturing the cleaner head member (100) according to any one of claims 1 to 10, the method comprising:

arranging (142) the cover member (116) over at least the cleaning liquid outlet structure (115) of the support substrate (114); and

perforating (144) the cover member to provide the plurality of openings (117) that extend through the cover member; optionally wherein the perforating is implemented following the arranging of the cover member over at least the cleaning liquid outlet structure.

12. The method (140) according to claim 11, wherein the perforating (144) comprises exposing the cover member (116) to a heat source.

13. The method (140) according to claim 12, wherein the heat source comprises at least one selected from laser beam(s) (152) and hot needle(s).

14. A cleaner head assembly (104) comprising:
the cleaner head member (100) according to any one of claims 1 to 10; and
a cleaner head (102) to which the cleaner head member is attachable and/or detachable.

15. A wet cleaning apparatus comprising:
the cleaner head member (100) according to any one of claims 1 to 10 or the cleaner head assembly (104) according to claim 14; and
a cleaning liquid supply for supplying cleaning liquid for delivery towards the surface to be cleaned via the cleaning liquid outlet structure (115) and the plurality of openings (117).