FRICITION TOOL FOR USE IN A COSMETIC METHOD

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ABSTRACT

A friction tool for use in a cosmetic method for the treatment of mammalian skin, the tool comprising a body defining a support having a planar support face; a resiliently deformable friction pad provided to the support face, the friction pad defining a friction face, the friction pad further comprising a net-like layer provided at said friction face such as integrally thereto, and a cosmetic method which can be performed using the friction tool.
FRICITION TOOL FOR USE IN A COSMETIC METHOD

FIELD OF THE INVENTION

There is described a fricition tool and fricition pad for use in a cosmetic method for application to mammalian skin. There is also described a suitable cosmetic method.

BACKGROUND TO THE INVENTION

To improve cosmetic appearance and for personal care purposes it is known to accelerate removal of flaking skin by exfoliating with mild abrasives by rubbing. It is therefore known to rub the skin with abrasive materials and tools capable of developing aggressive friction at the surface of the skin.

In one example, a loofah is used as the tool, wherein a loofah is a bundle of natural or synthetic fibres that is used to exfoliate during bathing by rubbing to remove dead skin. To avoid discomfort such exfoliation is often done with fluids that lubricate the interface and moderate skin damage caused by the abrasion.

In an extreme variant, cosmetic surgeons use the term excoriation to describe a method where significant amounts of the epidermal layer are removed, usually done with abrasives by rubbing or scraping with a sharp instrument, which causes discomfort and is usually done under anaesthetic.

Massage techniques are also known. Massage may generally be described as the practice of applying structured pressure, tension, motion or vibration, manually or with mechanical aids, to the soft tissues of the body, including muscles, connective tissue, tendons, ligaments, and joints, to achieve beneficial response. Massage is performed with hands, feet, elbows and a variety of shaped tools. The term ‘friction massage’ is used to describe these massage treatments. The purpose of ‘friction massage’ is however, not to treat the surface layers of the skin, but rather to treat deep tissues attached to skeletal members. It is often performed through a layer of clothing to prevent friction damage to skin. However, where performed directly the skin is generally lubricated to reduce actual skin friction during massage. Thus, it is a primary objective in massage methods including ‘friction massage’ to minimise friction at the skin.

Skin cleansing techniques are also known in which a pad supported by the user’s hand or finger or alternatively, on a tool is brought into rubbing contact with the skin. PCT Patent Application No. WO 2006/019507 for example, in the name of Zuko, LLC describes one suitable tool. Such techniques conventionally avoid aggressive frictional contact at the surface of the skin (see paragraph [00067] of ‘057) to avoid “pulling” of the skin because such pulling can stretch and lead to premature wrinkling of the skin.

Applicant’s co-pending PCT patent application no. WO2007/138,287 the entire contents of which are herein incorporated by reference describes a new kind of cosmetic method and tools suitable for use therein, in which a particular kind of frictional contact is necessarily employed at the skin surface. In that method a frictional face of the tool is brought into frictional contact with the outer (i.e. cutaneous) surface layer of the skin to be treated. A degree of downward force is applied, and the frictional face of the tool is moved (e.g. by a stroking movement) in a direction generally parallel to the outer surface layer of the skin such that the outer surface layer of the skin is gripped thereby, and therefore moves with the frictional face of the tool. Any uneven “pulling” of the outer surface layer of the skin is thereby, avoided. Importantly, during such movement one or more underlying (i.e. subcutaneous) layers of the skin are subject to lateral (e.g. shear) stress, which Applicant describes to result in desirable “exercise” or “training” of those one or more underlying skin layers, which gives rise to a cosmetic skin appearance benefit.

The method of Applicant’s co-pending PCT patent application WO2007/138,287 differs from both exfoliation and excoriation techniques because aggregative (i.e. damaging) frictional rubbing contact at the outer layer of the skin is avoided. Rather, in the method described therein, that outer layer of skin is gripped by the friction face of the tool, and moves with that friction face. This method also differs from ‘friction massage’ and ‘skin cleansing’ techniques because these seek to avoid any “pulling” of the skin, whereas the method described therein deliberately induces lateral stress across the gripped cutaneous layer (the skin), which strains subcutaneous tissue attached thereto.

Thus, in summary, the prior art has been appreciated to disclose tools and methods for exfoliating, excoriating, massaging and/or cleansing cutaneous tissues, but other than Applicant’s co-pending PCT patent application no. WO2007/138,287 does not disclose or anticipate tools or a method for exercising and training subcutaneous tissues by applying high levels of lateral stress sufficient to strain and distort such tissues in suitably correcting bulk distortion, with an equal and opposite following stroke.

Applicant has now devised various improvements to the tool and method described in Applicant’s co-pending PCT patent application no. WO2007/138,287. Thus, the problem addressed by the claimed invention is to provide improvements to a method and tool (apparatus) for use therein that can rapidly apply sufficient lateral stress to exercise the skin evenly down into the subcutaneous tissues, including associated connective tissues and muscles without negatively affecting the skin or the subcutaneous tissue. The problem is solved by use of the friction tool, friction pad therefore and method now described herein. The method herein may in embodiments, be conducted while applying cleaning or cosmetic formulations or shaving lubricants to the skin, which skin is known to have hair follicles defined thereon.

It is customary when removing bodily hair by shaving or depilatory techniques to apply a lubricant to minimise discomfort. Traditionally the lubricant is a soap applied by brush to create foam. Recently foaming and non foaming formulations applied by finger or spray have proven quicker to apply.

It is known that the condition of hair significantly influences shaving comfort and efficiency, for example it is said that a hair saturated with water loses more than half its ultimate tensile strength (uts). Applicant has now realized that by systematically exercising hair at the skin surface during application of a wet shaving formulation at higher levels of friction than is practical with a traditional shaving brush this will accelerate adsorption. Applicant has found that by rubbing hair to be shaved or subjected to depilatory techniques with the frictional tool herein that is arranged to exercise the hair and its supporting skin in a systematic way improves wetting of the hair with shaving formulation and generally improves the efficiency of shaving or hair removal by depilatory techniques. Razor blade life may thereby, also be extended. In embodiments, the frictional tool itself may be used to store and apply the shaving or depilatory formulation.
[0012] In embodiments, Applicant has found that rubbing the hair and skin with a friction tool having a friction pad defining a friction face with horizontally orientated fibres that are substantially supported at both ends, rather than at a single end as in a brush is beneficial. One suitable arrangement takes the form of a flexible fine net or meshed layer supported by an absorbent resilient body. Conveniently a mesh or net-like layer defining a friction face can be formed on the surface of a friction pad, which in embodiments has the form of a lofty non-woven web.

SUMMARY OF THE INVENTION

[0013] According to one aspect of the present invention there is provided a friction tool for use in a cosmetic method for the treatment of mammalian skin, the tool comprising a body; said body defining a support having a planar support face; a resiliently deformable friction pad provided to said support face, said friction pad defining a friction face, wherein the friction pad further comprises a net-like layer provided at said friction face.

[0014] According to another aspect of the present invention there is provided a friction pad for use with the friction tool herein, the friction pad being resiliently deformable and defining a friction face, wherein the friction pad further comprises a net-like layer provided at said friction face.

[0015] According to another aspect of the present invention there is provided a method of making a friction pad herein comprising the steps of: selecting a pad of lofty non-woven fibre material comprising a generally random arrangement of fibre materials, said pad defining a friction face; and applying a shaping tool to said friction face of the pad to selectively order said generally random arrangement of fibre materials at the friction face thereof such as to define a net-like layer thereof.

[0016] According to another aspect of the present invention there is provided a cosmetic method for the treatment of mammalian skin by means of a friction tool with a friction face as defined herein, the method comprising: bringing said friction face of said tool into contact with an outer skin surface of a cutaneous layer of said mammalian skin; applying a vector force to said tool; the vector force comprising a first vector component and a second vector component, wherein said first vector component acts normal to said outer skin surface to hold the friction face of the tool in constant frictional contact with a defined area of the outer skin surface and to apply compressive force to one or more subcutaneous layers of the mammalian skin underlying said cutaneous layer; and the second vector component acts parallel to the outer skin surface such as to laterally displace said defined area of the outer skin, thereby applying lateral stress to said one or more subcutaneous layers.

DETAILED DESCRIPTION OF THE INVENTION

[0017] There is described a friction tool and friction pad arranged for use in a cosmetic method for the treatment of mammalian skin. There are also described details of a suitable cosmetic method.

Friction Tool

[0018] The friction tool herein is suitable for use in a cosmetic method for the treatment of mammalian skin. The cosmetic method preferably includes the method steps as described herein, but the friction tool may in other embodiments also be employed in other cosmetic methods having different method steps.

[0019] The friction tool comprises a body, which body defines a support having a planar support face. Planar is used herein to describe a predominant association with a particular plane, which means the support face may be substantially flat although not perfectly flat, thus the surface may also be slightly curved in one or more planes. Suitably, the support face is stiff along at least one axis. A resiliently deformable friction pad is provided to the support face. The friction pad defines a friction face. The friction pad is suitably resiliently deformable to comply with deflections of the planar support face.

[0020] In one embodiment, particularly suitable for use in shaving and depilatory methods the friction pad comprises a lofty non-woven fibre material. The lofty spaced apart nature of the fibre is arranged for mechanical engagement with the hairs of an adult male face, thereby producing significant friction between those hairs on the surface of the adult male face and the frictional face of the pad.

[0021] The friction pad further comprises a net-like layer provided to the friction face. The net-like layer defines a preferably regular, net or mesh like matrix arranged for frictional engagement as described herein.

[0022] In embodiments, the net-like layer is provided as a separate layer (e.g. over-layer) to the friction face.

[0023] In embodiments, the net-like layer is provided as an integral layer to the friction face. That is to say, the net-like layer is provided by adapting (e.g. by joining or fusing appropriate parts thereof) the friction pad itself such as to define a net-like layer integral therewith (i.e. as an integral part thereof). In embodiments, the friction face is provided with a net-like arrangement (e.g. matrix like) of bonded fibres spaced relative to each other.

[0024] In embodiments, the net-like layer comprises a web of entangled interlaced randomly orientated non-woven fibres defining a layer of irregularly meshed net.

[0025] In embodiments, the net-like layer comprises spaced apart fibres, a proportion of the fibres bonded with a defined matrix of bonds between adjacent crossing fibres at the first face, thereby forming an open net like flexible resilient surface, with a proportion of bonded together fibres interspersed with un-bonded fibres.

[0026] In embodiments, the fibres are spaced apart and bonded in relation to the density of hair on the target rubbed skin so that upon pressing against the skin and sliding the hairs (e.g. wetted) freely engage and disengage with the mesh.

[0027] In embodiments, the friction pad defines an open non-woven web with a proportion of its adjacent fibres selectively bonded together at and near its rubbing surface to create a structure of bonds that resembles and behaves like a net.

[0028] In embodiments, the net-like layer is defined by a net-like arrangement of fibre bonds (e.g. bonded fibres) spaced relative to each other. In embodiments, the fibre bonds are defined by applying binder (e.g. adhesive binder) material at spaced intervals (e.g. in matrix-like fashion) to bind a net-like arrangement of (e.g. adhesive) bonds in the lofty non-woven fibre material. In embodiments, said binder material may be applied to the web by any suitable method such as moulding, painting, spraying-on and/or applying a layer of binder material. In embodiments, the binder material is a hot melt, optionally curable binder material. In embodiments, the
binder material is selected from the group consisting of latexes, polyamides, polyesters, polyolefins and any combinations thereof. In embodiments, the binder material has anti-microbial properties.

[0029] In embodiments, the net-like layer comprises irregularly oriented fibres bonded together with a regular net-like arrangement of bonds between adjacent fibres thereof. In embodiments, the bonds are comprised of a friction (e.g. friction-enhancing) material such as a material that has a dry coefficient of friction if slid against dry mammalian skin of greater than 0.5, preferably greater than 0.8 such as greater than 1.0.

[0030] In embodiments, net openings are defined by the interspacing of the net-like arrangement of fibre bonds of the net-like layer (i.e. in the spaces in-between the net-like arrangement of fibre bonds) and corresponding void volumes are provided in the lofty non-woven fibre material (i.e. in the “bulk” of the friction pad), which void volumes lie immediately behind each net opening and are thus, in registration with each net opening. In shaving applications, the void volumes act such as to better entrap the hairs of the user’s skin when the tool is passed over a skin surface to be shaved.

[0031] Applicant has found that the application of shaving formulations or depilatory preparations with a friction pad herein, such as one that defines predominantly horizontally orientated non-woven fibres in a rubbing face carried and supported on a soft resilient body like a sponge or lofty non-woven web, is most comfortable when the fibre spacing and more importantly the regularity and spacing of bonds joining said fibres together are selected to match the hair spacing in a way that avoids entanglement.

[0032] In embodiments, the shaving formulations and/or depilatory preparations comprise chemical wetting agents that are arranged for wetting of the hair at and protruding from the skin surface of the user.

[0033] In embodiments, the net-like layer (e.g. defined by the spacing of the bonds) is arranged in a regular grid with a spacing between nodes thereof (e.g. defined by the bonds) of between 1 mm and 20 mm such as between 1 mm and 8 mm apart. The thickness of the mesh layer is suitably in the range 0.1 to 5 mm. Such a web can improve the quality of a daily shave when used to rub on a shaving formulation by virtue of the friction face exercising hairs by lifting, bending and stretching the hairs and thoroughly wetting probably by opening the outer layers of the cuticles (hair shafts) as the direction of rubbing alternates, which causes a ‘back combing effect’ that is known to damage hair, but in this case it improves adsorption and thereby softens the hair shaft and reduces the force required to cut.

[0034] In embodiments, the net-like layer is provided with one or more projections (e.g. of fibre binding material) that project into the friction pad. Such projections act functionally such as to provide a degree of structure to the friction pad (e.g. by affecting the deformability thereof in one or more directions). In embodiments, each of said one or more projections is provided at a node of the net-like layer. In embodiments, the one or more projections project normally away from the net-like layer and into the friction pad. In embodiments, each of the one or more projections has a column or tapering column-like form. In embodiments, the one or more projections are formed as extrusions of the net-like layer.

[0035] In embodiments, some or all of the projections define a hollow interior space therein. In embodiments, the projections define a column or tapering column-like form, which column or tapering column-like form defines a hollow interior. In embodiments, the hollow-like interior is arranged for the receipt of chemical formulations. In embodiments, sealing means (e.g. in the form of a sealing layer or backing sheet) are provided to the friction pad for sealing off each hollow interior of the projections. In embodiments, the sealing means is arranged to be breakable on friction contact with skin of the user to thereby, release the contents thereof.

[0036] In embodiments, the friction pad has a net-like layer bonded to tapered bristle like hollow inserts providing sealable cavities, sealed with a backing sheet thereover. The cavities suitable for filling and storing a first chemical fluid therein separated from a second chemical fluid stored (held) between the fibres of the non-woven web surrounding said bristle like inserts. In a further embodiment the tips of tapered hollow bristles are bonded by the binder blobs that upon rubbing the friction pad against a surface the blobs fracture the tapered inserts towards their bonded tips and release said first fluids. In embodiments if the first stored fluid is a surfactant and the second stored fluid is water, upon fracturing the cone the surfactant mix with the water and reduces its surface tension and flows out onto the surface being rubbed.

[0037] In embodiments, the net-like arrangement of bonded fibres spaced relative to each other is provided with cross-ties formable as extrusions of the net-like layer.

[0038] In embodiments, the fibre bonds of the net-like layer and any extrusions defining projections and/or cross ties thereof are comprised of a resilient material such as a material that is resilient after curing thereof.

[0039] In embodiments, the fibre bonds of the net-like layer and any extrusions thereof are comprised of a blend (e.g. binder) materials each component material of said blend having a different melting point. Such embodiments may for example, be made by a process in which, a proportion of lower melting point fibres are introduced into the web and selectively re-melting a proportion of the fibres.

[0040] In embodiments, there are provided a friction pad for use with the friction tool herein and also a method of making a friction pad herein. The method of making a friction pad comprises the steps of selecting a pad of lofty non-woven fibre material comprising a generally random arrangement of fibre materials, said pad defining a friction face; and applying a shaping tool to said friction face of the pad to selectively order said generally random arrangement of fibre materials at the friction face thereof such as to define a net-like layer thereon. In embodiments, the shaping tool defines a shaping face that includes a matrix of shaping projections arranged to define the desired net-like ordering of the lofty non-woven fibre materials of the friction face of the pad when brought into shaping contact therewith.

[0041] In embodiments, the method additionally comprises the step of applying binder material at spaced intervals (e.g. in matrix-like fashion) to bind a net-like arrangement of fibre bonds spaced relative to each other in the lofty non-woven fibre material such as to further define the net-like layer.

[0042] In embodiments, net openings are defined by the interspacing of the net-like layer arrangement of fibre bonds and the method additionally comprising the step of providing corresponding void volumes in the lofty non-woven fibre material immediately behind each net opening such as by means of a shaping tool, which may be integral with the shaping tool that defines the net-like shaping or as a separate tool therefrom, such as one having a matrix of void shaping projections arranged to define the desired provision of void
volumes in the lofty non-woven fibre materials of the friction face of the pad when brought into void shaping contact therewith.

[0043] In embodiments, the method additionally comprises the step of extruding the net-like layer arrangement of fibre binding material (bonds) to provide one or more projections that project into the friction pad to provide a degree of structure thereto. In embodiments, the method additionally comprises the step of extruding the net-like layer arrangement of fibre binding material (bonds) to form cross-ties at the fibre bonds of the net-like layer.

[0044] In embodiments, the method additionally comprising the step of providing one or more pre-defined bristle-like projections that project into the friction pad to provide a degree of structure thereto. In embodiments, the method additionally comprising the step of providing a pre-defined net-like form to the net-like layer arrangement of fibre bonds to define cross-ties at the fibre bonds of the net-like layer.

[0045] Applicant has also found that fuzz or linting (pulling out of non-woven fibres as they catch against beard stubble) may be reduced by spot bonding surface fibres of the friction pad. Thus discomfort of rubbing the skin is minimised by forming a soft resilient net of fibres bonded at a proportion of fibre crossing points and supported (carried on) a soft resilient absorbent body. Thus, in embodiments the friction tool herein employs a resilient deformable (e.g. absorbent) body on which the surface net-like layer or mesh forming the friction face is carried/mounted. In embodiments, the resilient deformable body is either a lofty non-woven three dimensional web or foam with interlinking cavities, both bodies capable of storing and dispensing shaving lubricant or a depilatory preparation. Thus, in embodiments the friction pad (e.g. lofty non-woven fibre material or foam) is impregnated with a chemical formulation such as one including a chemical wetting agent.

[0046] In embodiments, the friction tool provides a thin layer of non-woven fibre with a friction face thereon, and the three dimensional mesh of irregular crosslinked fibres, assumes a near two dimensional irregular mesh like contact pattern when pressed against the skin.

[0047] In embodiments, the bonds between fibres may be either welds or small globules of adhesive binder, which globules are smooth and also act as rubbing pads, these adhesive pads preferably made of grippy resilient thermoplastic. The fibres optionally coated with a friction grip enhancing layer. The fibre mesh spacing chosen to maximise engagement with human hairs and the pads frictionally engage with the skin and collectively exercise both the hairs and adjacent cutaneous and subcutaneous tissue.

[0048] In embodiments, the bonding between the fibres prevents the fibres from excessive "pull out" giving it so called abrasion resistance. Abrasion resistance can be characterized by the tendency of a non-woven to "fuzz," which characteristic may also be described as "limiting" or "pilling." Fuzzing occurs as fibres or small bundles of fibres, are rubbed off, pulled off, or otherwise released from the surface of the non-woven web. Fuzzing can result in fibres remaining on the skin or clothing of the wearer or others, as well as a loss of integrity in the non-woven, both highly undesirable conditions for users.

[0049] Fuzzing can be controlled in much the same way that strength is imparted, that is, by bonding or entangling adjacent fibres in the non-woven web to one another. To the extent that fibres of the non-woven web are bonded to, or entangled with, one another, strength can be increased, and fuzzing levels can be controlled.

[0050] Softness can be improved by mechanically post treating a non-woven, for example, by incrementally stretching a non-woven web by the method disclosed in U.S. Pat. No. 5,626,571 the non-woven can be made soft and extensible, while retaining sufficient strength for use in disposable absorbent articles. In embodiments, a non-woven web can be made soft and extensible by employing opposed pressure applicators having three-dimensional surfaces which at least to a degree are complementary to one another. In other embodiments, a non-woven web which is soft and strong may be made by permanently stretching an inelastic base non-woven in the cross-machine direction.

[0051] One method of bonding, or "consolidating", a non-woven web is to bond adjacent fibres in a regular pattern of spaced, thermal spot bonds. One suitable method of thermal bonding is described in U.S. Pat. No. 3,855,046, which teaches a thermal bond pattern having a 10-25% bond area (termed "consolidation area" herein) to render the surfaces of the non-woven web abrasion resistant. However, even greater abrasion resistance together with increased softness can further benefit the use of non-woven webs for use herein.

[0052] By increasing the size of the bond sites, or by decreasing the distance between bond sites, more fibres are bonded, and abrasion resistance can be increased (e.g. fuzzing can be reduced). However, the corresponding increase in bond area of the non-woven also increases the bending rigidity (i.e., stiffness), which is inversely related to a perception of softness (i.e. as bending rigidity increases, softness decreases). In other words, abrasion resistance is directly proportional to bending rigidity when achieved by known methods. Because abrasion resistance correlates to fuzzing, and bending resistance correlates to perceived softness, known methods of non-woven production require a trade-off between the fuzzing and softness properties of a non-woven.

[0053] The above used term "abrasion resistance" refers to the abrasive effect of mammalian hair and skin on the tools friction face; concurrently if the tools friction face is made with materials that are harder than skin, which compressed non woven fibres can be, the tool will also be mildly abrasive to skin. In embodiments, the friction face is mildly abrasive to skin, the abrasion being typically no more than that employed for exfoliation of human skin.

[0054] In embodiments, bond patterns may be utilized to improve strength and abrasion resistance in the non-woven material of the friction pad while maintaining or even improving softness. Various bond patterns have been developed to achieve improved abrasion resistance without too negatively affecting softness. However, with all bond pattern solutions it is believed that the essential trade-off between bond area and softness remains.

[0055] In embodiments, the friction pad provides a three dimensionally interlaced low density resilient non-woven foam-like layer of fibre in the form of a thin web with apertures therein (void volume), the apertures optionally penetrating part way through the layer. The layer may be an integral part of a non-woven web or a separate layer attached to a non-woven web or a layer attached to some other resilient body such as foam.

[0056] In embodiments, the friction pad provides a non-woven fibre surface with varying density of fibres, the variation of density affected by varying the spacing of the fibres. The spacing of the fibres selected so that when pressed against
The majority of the fibres within the surface layer align parallel with the skin. The space between the fibres at and near the rubbing surface selected to allow hair to penetrate into the fibre layer and provide desired frictional engagement therewith. The spacing between the fibres varied to match the average hair density distribution on various parts of the human body.

The distribution or density of hair varies over the adult human body in the range from 250 follicles/cm² on the scalp and forehead to as low as 10 follicles/cm² in the shaved areas of the beard and most other shaved areas such as calf, thigh, forearm, thorax, etc. Thus, during sliding of the formed layer over a skin surface with hair appended thereto, hairs individually will penetrate into the non-woven fibre layer and frictionally engage and then disengage without locking, for this the fibres must be spaced apart. The actual spacing chosen to provide apertures or open spaces within the facial layer so that ideally each hair is surrounded by one or more fibres the fibres separating the hairs and either lifting them up, redirecting them, pulling them gently and pressing them down as sliding proceeds, on average the fibre spacing is such that after pressing the hair down it has space in which to spring back up before being engaged with the next sliding fibre.

Thus the average spacing between fibres within the net-like layer of the friction pad that defines the apertures into which the hair shafts frictionally engage will relate to the density of between 10 to 40 follicles/cm² for facial and body shaving and 50 to 250 follicles/cm² for head shaving. Owing to the cyclical nature of hair regeneration roughly 20% of the follicles may not bear hair at any one time.

The harshness of the friction face when rubbed against the skin is one of personal choice, depending upon toughness and density of hair shafts, sensitivity and condition of skin etc. Applicant has found that the most favourable relationship between the hair shaft density and aperture size is in the range 2 to 4 hairs/aperture. As the hair density increases it becomes progressively more difficult and uncomfortable to slide with a fine friction face.

In embodiments, in the net-like layer a proportion of the surface and near surface crossing fibres are positioned and bonded together, then when lightly pressed against the skin the crossed bonded fibres resemble an open irregular mesh, the average size of the mesh openings (gripping) chosen to allow hairs appended to the skin freely penetrate into the web and thereby form a frictional coupling that resists sliding. In use, the friction tool functions to apply mechanical forces to the skin first by direct frictional contact with the skin and second via hairs appended thereto, as the friction tool slides across the skin.

It is believed that the applied forces exercise the skin, especially the arrector pili muscles associated with each hair follicle, repeatedly stretching and compressing the muscle by rubbing with and against the nap (the inclined direction of the follicle and hair shaft). The repeated exercise causes hypertrophy within the muscle and strengthening it, which causes it to firm up and swell and shorten slightly.

The friction tool repeatedly bends and fatigues the hairs causing damage to the layered outer sheath of the hair, disturbing said layers and progressively lifting the outer keratin flakes (layers) as the fibres scrape and abrade the hair shafts, which damage accelerates absorption of fluids between the layers and inwards towards the hairs fibrous cortex. This affects to soften the hair and reduce cut forces and resultant abrasion, which can improve razor blade life.

The process improves chemical wetting by forcing fluid down into the follicle, which action can improve the effectiveness of chemical depilatory products.

Suitable non-woven fibre materials include those used as filter media which employ a relatively thick web or sheet of fine usually synthetic fibres with small air gaps between. The term lofty non-woven as used herein defines a body of spaced apart (low density of) fibres in a sheet or web with significant thickness. In this spaced apart structure fibres are randomly oriented (jumbled together) and left mostly in point contact with each other resulting in significant gaps between the fibres. As noted herein before the webs may be further shaped to change said gaps between fibres and form a net-like structure with void spaces (net openings) at its surface and a void volume behind each void space in the net-like face. The term void space defines a three dimensional space within the lofty non woven web, in which space fibres have larger gaps between them than in the regular web.

Depending upon the method of manufacture the friction pad may be formed with fibres of relatively short lengths of between 5 and 20 mm or longer filaments of virtually indeterminate length. In embodiments, the friction pad defines relatively stiff vertical supports (e.g. a bit like a stiff bristle). In embodiments, these vertical supports are bonded, and the array of vertical bonded bodies are arranged to resemble the bristles of a brush with very short spaced apart bristles terminated on the net, the cellular void spaces therein partly filled with lofty non-woven fibres. The behaviour of this arrangement may be visualised as a pad with short stiff bristles pushed through a soft non-woven web and the ends of the bristles bonded onto bunched up non-woven fibres to form the net like planar rubbing face.

In embodiments, the friction pad defines a soft resilient porous friction face made with polymeric materials in the form of a planar open mesh net of polymeric filaments oriented predominantly in a first and second plane both predominantly parallel to a planar surface. In embodiments, a proportion of the crossing filaments are bonded at some touching points and a proportion of the bonds made with polymeric material. In embodiments, the bonds in the form of bodies also bond with further polymeric fibres oriented predominantly in a third plane generally normal to the first and second planes, thereby providing support for the face mesh. In embodiments, the bonds have bodily shape and stiffness. In embodiments, the friction face mesh has two dimensional void spaces leading to three dimensional void spaces otherwise described as volumes bounded by the mesh and supporting fibres. In embodiments, each bond body has a smooth face so that bonds exposed at the friction face contribute to the pads frictional properties during rubbing. In embodiments, during sliding the bonding bodies rub against a treatable surface and drag filaments strung between bonding bodies across the surface. In embodiments, the bonding bodies and string fibres are spaced to allow protrusions on the treatable surface to frictionally engage therewith and disengage therefrom as sliding proceeds. In embodiments the bonds may protrude outwards from (prong of) the fibres forming the net-like layer.

Fibres suitable for use in the friction pad herein include natural and synthetic fibres, and mixtures thereof. Synthetic fibres are preferred including those made of a polymeric material such as polyester (e.g., polyethylene terephthalate), nylon (e.g., hexamethylene adipamide, polyacrolactum), polypropylene, acrylic (formed from a polymer of
acrylonitrile), rayon, cellulose acetate, polyvinylidene chloride-vinyl chloride copolymers, vinyl chloride-acrylonitrile copolymers, polyolefins, polyamides, polycarbonates, polystyrenes, thermoplastic elastomers, fluoropolymers, vinyl polymers, viscose polymers and blends and cross-linked copolymers thereof. Suitable natural fibres include those of cotton, wool, jute, and hemp. The fibre material can be a homogenous fibre or a composite fibre, such as bi-component fibre (e.g., a co-spun sheath-core fibre). It is also within the scope of the invention to provide an article comprising different fibres in different portions of the web (e.g., a first web portion, a second web portion and a middle web portion). The fibres of the web are preferably tensilized and crimped but may also be continuous filaments such as those formed by an extrusion process as for example, described in U.S. Pat. No. 4,227,350. The fibres may be in the form of a woven, a knit or a non-woven web, either a thin hydro-entangled, spun-bond or melt-blown into thin wipe like material, or a thicker needle punched felt like web or a lofty randomly bonded open structure, perhaps bonded with an acryl binder typical of filter media or resins typical of securing pads or some combination formed with layers of these.

[0067] The web may be stabilized by bonding a proportion of the contacting fibres throughout the web to form a three dimensional integrated structure, forming gobules at the points of mutual contact while the interstices between the fibres remain substantially unfilled. Typical methods of bonding may take the form of dipping or spraying with a curable adhesive or resin or spraying with molten polymers that condense at contacting junctions. An alternative is to introduce a proportion of lower melting point fibres into the web and selectively re-melting a proportion of the fibres. A further method employs hot needles plunged into the web. Elongated bonds (for example to form stiffening columns) are made by inserting an array of extrusion tubes into the web or an array of dispensing orifices onto a formed web and extruding beads of binding agent in the desired pattern.

[0068] There are many variations on the basic method of manufacture of lofty non-woven fibre webs, typical of these are air-laid, carded, stitch bonded, spun bonded, wet laid, or melt blown procedures.

[0069] In embodiments, to provide a suitable frictional rubbing face the fibres at the sliding/rubbing surface may be arranged to take the form of a moderately regular meshed grid in which a proportion of the exposed contacts between fibres are bonded with a bonding medium to stabilize and stiffen the mesh and thereby provide desirable mechanical properties for treating hair and skin with friction.

[0070] In embodiments, the friction pad is made from or includes a plurality of randomly interlaced thermoplastic fibres mechanically entangled with uniform distribution of voids (spaces) therewith bonded contacts providing a lofty non-woven web having a basis weight of at least 20 grams per square meter. In embodiments, the basis weight range will vary from about 40 to about 68 grams per square meter. The web can be made entirely from bi-component fibres which are typically crimped and which will generally have a fibre denier equal to or greater than 2. Alternatively, the web can be made from a combination of fibres such as bi-component fibres and polyester fibres. In such embodiments, the web will usually include at least 50 percent by weight bi-component fibres. The resultant web will have a void volume of between about 80 and about 117 cubic centimetres per gram of web at 689 dynes per square centimetre pressure, a permeability of about 8,000 to about 15,000 darcy, a porosity of about 98.6 to about 99.4 percent, a surface area per void volume of about 10 to about 25 square centimetres per cubic centimetre, a saturation capacity between about 55 and about 80 grams of 0.9 percent saline solution per gram of web and a compression resilience in both the wet and dry state of at least about 60 percent.

[0071] Crimped or curly fibres may be used in the body of the friction pad, since they provide an extra open and lofty structure. It is also possible to use a combination of straight and crimped or curled fibres.

[0072] The term lofty herein is used to describe a structure with 'loft' or height and is used to describe a web of interlaced spaced apart non-woven fibres in the form of a three dimensional fibrous matrix, with fibres orientated and spaced and only occasionally touching. In embodiments, a proportion of the fibres are bonded together where they touch. The fibres spaced apart sufficiently for bodily hairs to frictionally penetrate the web and frictionally engage therewith as the tool slides over the skin, the hair appended to mammalian skin. The matrix spacing optimised for the hairs to penetrate into the matrix during sliding. In particular the fibre spacing is chosen to maximise sequential scraping, bending, stretching and compressing of the hair shaft, during reciprocating sliding and frictional contact with the skin to also cause deformation (opening and closing) of its associated follicle.

[0073] In embodiments, the fibres non-woven web is made with a plurality of fibres randomly orientated and intermixed so that they are predominantly spaced apart touching typically for less than 1% of their surfaces, the spacing sufficient to allow direct light to pass through a 5 mm thick web.

[0074] In embodiments, the fibres of the non-woven fibre material have a length of greater than 5 mm such as from 5 to 20 mm.

[0075] In embodiments, the web has a first and second face and the fibres at the first face are formed into a friction face by dressing and bonding into an irregular mesh to provide a strong grid in which the average spacing between fibres relates to hair spacing.

[0076] In embodiments, the net-like layer is formed during a further process step that follows the basic manufacture of the non-woven web by the further steps of inserting forming pegs into the face of the non-woven web to create apertures either part way or fully through the web and positioning bonds between the apertures to retain the displaced formed fibres. In embodiments, the forming pegs are warm so as to thermoform the apertures.

[0077] Applicant has also found that it is desirable in use of the tool herein to avoid high stress transitions at the sliding interface with the skin as an edge of the frictional face of the friction pad slidingly engages an outer (cutaneous) layer of the skin. In a first embodiment herein, such high stress edge transitions are essentially avoided by providing ‘soft’ edges to the frictional tool. Thus, one or more edges of the friction face of the friction pad project beyond the planar support face to provide less support and soft edges. In a second embodiment herein, such high stress edge transitions are reduced by maximising the area of frictional contact thereby minimising the edge transitions experienced at a point on an outer skin surface as it is treated.

[0078] In embodiments, the body of the friction tool includes a handle for manual holding thereof. In embodiments, the handle is provided to one end of a shaft from which extends the support.
In embodiments, the friction pad comprises a flexible resilient material and the body of the friction tool comprises a stiffer material.

In embodiments, the friction face is rough, comprising many irregularly shaped, flexibly interconnected friction elements that interlock with the skin roughness to provide high levels of lateral static and dynamic frictional coupling when pressed against mammalian skin.

In embodiments, an edge on the friction face is less stiff than its central area.

In embodiments, the friction pad comprises polymer fibres that are mainly oriented in the x and y planes parallel to rubbed surface.

In embodiments, the support of the friction tool is coupled by members to a holdable area distant from the friction pad.

In embodiments, the support face and friction face are shaped either as a rectangle, a triangle, a circle or an oval or a combination thereof.

In embodiments, the support face of the friction tool has a flat area defined by dimensions in the x and y plane and has formed features in the z plane such as a radius or chamfer around the edges.

In embodiments, the friction tool additionally comprises a hand holdable hollow object with fillable space therein and with means of dispensing stuff therefrom, wherein the friction face attaches to the hollow object.

In embodiments, the friction tool additionally comprises a hand holdable hollow object with a multiplicity of friction pads stacked therein each with a friction face thereon, the tool with means of releasing friction bodies one at a time via an orifice. In embodiments, the stacked friction pads are impregnated with a chemical formulation.

In embodiments, the support face of the friction tool is a face on a fillable container or the end cap of a container.

In embodiments, the friction face mounts on the exterior of the body and with fluid stored within the body for dispensing therefrom.

In embodiments, the body comprises a hand holdable planar trowel like form with the support attaching thereto.

In embodiments, the friction tool additionally comprises a second face for rubbing located on a second face on the tool.

In embodiments, the friction pad is detachably attached to the body.

In embodiments, static friction pads are positioned either side of an alternating pad.

In embodiments, a lateral force applied to alternate a pad carrying a friction face is provided by a powered device.

In embodiments, the non-woven fibres are only occasionally touching. In embodiments, the non-woven fibres are spaced apart and touch each other at less than 1% of the surfaces thereon. In embodiments, a proportion of the fibres are bonded together where they touch.

In embodiments, the non-woven fibres spaced apart sufficiently for bodily hairs to frictionally penetrate the web and frictionally engage therewith as the tool slides over the skin, the hair appended to mammalian skin. In embodiments, the matrix spacing is optimised for the hairs to penetrate into the matrix during sliding. In particular the fibre spacing is chosen to maximise sequential scraping, bending, stretching and compressing of the hair shaft during reciprocating sliding and frictional contact with the skin to also cause deformation (opening and closing) of its associated follicle.

In embodiments, the non-woven fibre material is made with a plurality of fibres randomly orientated and intermixed so that they are predominantly spaced apart touching typically for less than 1% of their surfaces, the spacing sufficient to allow direct light to pass through a 5 mm thick web.

In embodiments, the non-woven fibre materials include those which employ a web or sheet of relatively closely packed (high density of) usually synthetic fibres with small air gaps therebetweens for insulation. The term lofty non-woven as used herein defines a body of spaced apart (low density of) fibres in a sheet or web with significant thickness. In this spaced apart structure fibres are randomly oriented (jumbled together) and left mostly in point contact with each other resulting in significant spaces (voids) between the fibres.

In embodiments, the lofty non-woven fibre material may be formed with relatively short lengths of between 5 and 20 mm or longer filaments of virtually indeterminate length. All fibres are flexible and may during and after assembly into the web assume complex directions with vectors in a first plane x and a second plane y, and a third z plane. The jumbled fibres beneficially interface in a manner that creates voids while providing the web with structural stability. Furthermore individual fibres may beneficially be crinkled to improve the stability and resilience of the web, generally the non-woven web.

The friction tool herein may be provided as a component of a shaving kit comprising (a) the friction tool; (b) a shaving razor; and (c) a shaving formulation.

Cosmetic Method

The cosmetic method herein is for the treatment of mammalian skin by the use of a friction tool herein. The method includes the step of bringing the friction face of the tool into contact with an outer skin surface of a cutaneous layer of the mammalian skin. The method then includes the step of applying a vector force to the tool. Such force may be applied manually by the user or by a third party (e.g. a beautician treating a client’s skin), or in embodiments be provided by mechanical means provided to the tool. The vector force comprises a first vector component and a second vector component.

The first vector component acts normal to the outer skin surface. The effect is firstly to hold the friction face of the tool in constant frictional contact with a defined area of the outer skin surface. Secondly, the effect is to apply compressive force to one or more subcutaneous layers of the mammalian tissue. Those subcutaneous layers underlie and are coupled to the cutaneous layer.

The second vector component acts parallel to the outer skin surface such as to laterally displace said defined area of the outer skin, thereby applying lateral stress to said one or more subcutaneous layers. In embodiments, the lateral displacement of the defined area of the outer skin surface is uniform across that defined area.

It has been found that such application of lateral (e.g. shear) stress at the one or more subcutaneous layers results in desirable “exercise” or “training” of those subcutaneous tissue layers by stressing and in some cases beneficially straining said tissues in and between said layers and where they exist against skeletal anchorages. This gives rise to a cosmetic skin appearance benefit such as improving bodily
shape and especially facial shape and the expressive facial features. For example, benefits may include an improved smile with less skin wrinkling, the possible net result being to offset aging effects by approximately five years on faces more than 40 years old.

[0105] The friction face of the tool is suitably brought into contact with the outer skin surface such that it deforms and follows the deformed profile thereof and makes even frictional contact therewith over a relatively large contact area.

[0106] Additionally, in the method herein the friction grip between tool and skin during any one stroking movement will depend upon: 1) The initial static coefficient of friction; 2) the subsequent kinetic or dynamic coefficient of friction, which is lower than the static value; 3) and the vector forces applied to the tool.

[0107] Surprisingly friction, by which is meant the resistance to sliding and therefore grip is theoretically independent of the area of contact. In the method, a tool is employed with a resiliently deformable face that when subjected to an externally applied vector force applies an even pressure over a relatively large area of skin thereby ensuring pressure is maintained uniformly at safe and comfortable levels and grip also is distributed evenly, avoiding differential slippage within the contact area during sliding, which would cause localized uneven stretching that distorts the outer layer of the cutaneous and subcutaneous tissue. Uneven stretching, by which is meant stretching that cannot be reversed by reversing the direction of rubbing causes uneven extension and this is a limitation (disadvantage) of time consuming finger massage (the process of rubbing one or two fingers in small circular motions while translucasion the circular orbits so that on average the direction of stretch at any random point is cancelled by an equal and opposite motion). Similar limitations occur when applying cosmetic formulations by hand (with one or more fingers pressed hard against the skin and sliding) because it limits the force that can be safely used. Similar problems are caused in deep massage processes.

[0108] Therefore the tools and cosmetic method of use provide a beneficial ‘grip and slide’ (slip) movement during stroking is defined by the application of uniform contact forces applied over a defined relatively large area, the area suitably being relative to four bunched fingers on a typical small female hand and is estimated to be greater than 450 mm² and preferably greater than 1000 mm², and still more preferably greater than 2000 mm² thereby enabling large areas of skin to be treated more rapidly. The conventional relationship between the static (grip) coefficient of friction and the dynamic (slip) coefficient is that the former is larger. This applies to said friction tool, therefore the lateral force vector is largest just prior to slip commencing. Thus the larger the number of direction reversals the more effective the method.

[0109] The direction of sliding being preferably along the longest axis of the friction face of the tool and the distance of sliding is preferably limited to 50% of the tool’s longest axis, especially when treating the face to minimise potentially distorting shear stress transitions within the skin at the sliding tool edge.

[0110] The cosmetic method herein may include the additional step of applying a cosmetic (e.g. topical) formulation to the outer skin surface. The cosmetic formulation may be in fluid (e.g. liquid, foam, powder or paste) or solid form. In embodiments, such application of cosmetic formulation may be performed either prior to, at the same time as or subsequent to the step of applying a vector force to the tool.

[0111] The exact nature of the cosmetic formulation will depend on the particular cosmetic effect to be enhanced and in embodiments, may be selected from skin care such as depilatory, cleansing, moisturising, colouring, anti-ageing or shaving formulations.

[0112] In embodiments, the cosmetic formulations are applied while simultaneously removing excess adipose (fatty) deposits from under the skin, and improving elasticity by training fibrous cutaneous tissues, firming muscles by hypertrophy and improving vascular and lymphatic functions, thereby further improving bodily shape and appearance.

[0113] In embodiments, the direction of the vector force alternates each cycle: in a first half cycle it operate in a first direction with a first vector component applying force normal to the skin and holding the friction face against the skin and the second vector component acts in a first direction parallel to the outer skin surface such as to apply a first lateral stress component to said one or more subcutaneous layers, and in a second half cycle the second vector component acts in a second (i.e. opposite to the first) direction parallel to the outer skin surface such as to apply a second lateral stress component to said one or more subcutaneous layers. In embodiments, the rates and magnitude of the second vector component in the first and second (i.e. opposing) directions are approximately equal.

[0114] To more fully exercise the one or more subcutaneous layers during each half cycle, the elastic limit of some subcutaneous tissue, which is visco-elastic, is exceeded and is distorted, the distortion being reversed during the next half cycle. By repetitively exercising the one or more subcutaneous layers with said alternating vector forces at regular intervals the bodily appearance is improved.

[0115] In embodiments, the vector force is applied in the approximate direction of the axis of contraction of nearby muscles and induces hypertrophy therein.

[0116] In embodiments, during each cycle the friction face that is in contact with the skin accelerates in a first direction and deforms the skin before and during sliding, then the friction face decelerates and stops, the friction face then accelerates in the second opposite direction and deforms the skin before and during sliding, then the friction face decelerates and stops.

[0117] In embodiments, the direction of sliding in the first direction is opposite the direction of sliding in the second direction save for any small displacements that translocate the tool across an area of skin.

[0118] In embodiments, the velocity of deformation is the same in the first and second half cycles.

[0119] In embodiments, the distance traveled by the friction face in either direction varies between 0.5 to 500 mm.

[0120] In embodiments, the coefficient of friction between the skin and the friction face rises above 0.5 at some point during each cycle.

[0121] In embodiments, a fluid film is placed between the friction face and the mammalian skin.

[0122] In embodiments, the fluid film includes a topically applied formulation that interacts with cutaneous tissue.

[0123] In embodiments, the topically applied formulation assists with cleaning, exfoliating, a depilatory process, a skin conditioning process, an anti-ageing process, a shaving process, or an antiseptic process.
In embodiments, the cosmetic method improves vascular and lymphatic functions, and reduces adipose deposits in subcutaneous tissues.

In embodiments, the cosmetic method is for treating human lips in which the average contact pressure ranges between $3.3 \times 10^{-5}$ and $4 \times 10^{-5}$ N/mm$^2$ over an area greater than 100 mm$^2$.

In embodiments, the cosmetic method is for treating parts of the human face in which average contact pressure ranges between $3.3 \times 10^{-7}$ and $1 \times 10^{-7}$ N/mm$^2$ applied over an area greater than 450 mm$^2$.

Additional Description of Friction Tool

The friction tool herein is suitably a chemical-mechanical tool employing a relatively large area high friction face that is pressed against the skin with a relatively moderate force to provide uniform frictional engagement with the skin over a relatively large area and moving said frictionally engaged area systematically over the skin by sliding backwards and forwards to exercise the tissues under and around the area of frictional engagement.

Unlike the background art, means are provided herein for visco-elastic subcutaneous tissue to be rapidly and deliberately strained laterally, first stretched then compressed to restore it to its original shape by alternating the direction of the applied stress. This is not done in the background art because it was said to be detrimental to strain the skin because of the risk of permanently enlarging it. The background art does not anticipate or disclose a friction tool herein designed to laterally strain subcutaneous tissue while only stressing associated cutaneous tissues, whilst simultaneously applying and rubbing in cosmetic substances.

In embodiments, the friction tool herein is sized so that a treatment lasts only a few minutes, typically less than 5 minutes, most commonly between 2 and 4 minutes, whereas typical massage treatments in the background art last typically 20 minutes.

The friction face of the friction tool herein, is suitably deformable, which means it is flexibly deformable because it is resiliently compressible, when pressed against a mammalian body it first deforms the body moderately then second it takes the shape of the deformed body after the body can deform no further thereby forming a relatively large uniform area of frictional engagement. Upon applying a vector force to slide the tool it laterally stresses and strains cutaneous tissue around but not within the frictionally engaged (gripped) area while stressing and straining subcutaneous tissue under the frictionally engaged area of skin.

The friction pad is mounted on a support, which supports the friction pad. The support may vary in construction from the one extreme where it is ridged to the other extreme of being highly flexible, but at all times the support is stiffer than the friction pad and the actual combined stiffness (stiffness meaning resistance to deformation), is chosen to meet the requirements of the tool function.

For example, a preferred use for the tool is massaging while applying shaving lubricants, for which the tool is only required to operate over the lower face and neck. It was found that the optimum size and shape roughly resembles a traditional shaving brush, with a soft (soft meaning easily deformable) resilient friction pad mounted on the end of a stiff (barely deformable) support that also acts as a container and/or dispenser. The friction pad and friction face located at one end or on a side towards an end or some similar combination as illustrated later by way of example later herein. Thus a fluid dispenser can be attached onto or incorporated into the tool.

In embodiments, the friction pad is made with less dense material than the support, the density of the material of the friction pad being in the range 10 to 120 kg.m$^{-3}$.

Suitably, a region on the support provides means of holding the tool. This region is an area for gripping either by human hand or by other means such as a mechanical device like a robot that simulates some or all of the motions that are provided by a human hand when using the tool. The actual operation of the tool when hand held is most commonly hand powered but may be power assisted by the addition of a vibrator device for added convenience.

For manual operation the support is shaped to be gripped between thumb and fingers or wedged between first and second finger; a further area is provided for applying additional pressure on the support, the further area pressed with fingers or the palm of the hand as illustrated by way of example later herein.

The support having a first region coupled to a second region, the second region being distant from the first region by an amount sufficient to keep the gripping or pressing fingers and hand away from the rubbed skin.

The support of the tool is in embodiments, shaped to accommodate within it, or have coupled to it, a reservoir for storing and dispensing a fluid during rubbing, the fluid in the form of a chemical formulation that provides a beneficial cosmetic function when rubbed onto the skin. The tribological properties of the applied compound and the amount applied are selected to provide friction levels compatible with those required to exercise the skin.

The resiliently deformable material of the friction pad and the friction face thereon is selected to be approximately similar or slightly stiffer (less deformable during compression) than the skin covering soft tissues on the lower human female face and less stiff than the skin covering skeletal bones about the chin and upper cheeks.

In embodiments, the friction pad is compressible within a range 1 to 90% (thickness reduction) over more than 50% of the area of the rubbing face thereon when subjected to a compressive force of 5 kPa (kg/m$^2$) for less than 0.5 seconds and upon fully unloading the compressive force the body recovers in less than 0.5 sec to a compression set of less than 50%. The term ‘compression set’ means the difference between the original or pre-compression thickness of the friction pad and its thickness after a specified period of recovery after fully removing the compression force.

Reference to skin stiffness herein means the resistance cutaneous and subcutaneous tissues collectively present when subjected to deformation, either in compression, tension or shear, this is influenced by the amount of soft tissue underlying the skin, which varies hugely over the human face. On the lower face cheeks there is deep soft tissue, perhaps 10 mm or more but on the forehead there is little soft tissue, perhaps less than 2 mm, therefore there is very little subcutaneous matter to deform. To treat bony areas, resilient first bodies are preferred that are compliant so they are able to adopt the shape of the bony area and prevent the contact pressures and shear stresses rising to levels where skin might be damaged.

A typically lofty low density non-woven web suitable for use as a friction pad is made with crinkled staple fibres of lengths of between 0.2 cm to 7 cm or with longer
(virtually continuous) straight fibres, the fibres coupled by needle punch entanglement, adhesive or resin bonded, or thermal bonding by blending in lower melting point fibres then heating to selectively melt these lower melt fibres—these webs being typical of those used for skin contact use such as make-up removal. They may take the form of a single or multilayered stuck, creped or pleated shaped to suit the purpose.

[0142] The friction pad and friction face thereon can be formed with micro-fibre materials, that means materials made with fibres less than one denier that means they typically use fibre diameters of less than 10 microns that are formed into woven cloths with many fibre ends that are split or otherwise treated to form hooks that catch dust and particulates and slice up grease deposits, they are therefore useful for cleaning skin. Because they entrap particulates they suffer from the risk of spreading infection, therefore if used as a friction face they should be used only once and then discarded.

[0143] Non-woven paper wipes, or polymer reinforced natural fibre wipes, or absorbent wipes made with materials such as viscose/polyester combinations may all be used as low cost friction face materials. They may form a single use device or be removable attached to a support. Wipes offer many possibilities for use as pre-wetted dispensing mediums for applying cosmetic and skin care treatments. These relatively thin wipes may actually constitute the entire friction pad of the tool with the friction face thereon and may conveniently be removeably attached directly onto the support.

[0144] The strength of wetted paper wipes proved to be a limiting factor during frictional rubbing; therefore paper wipes are suited only to applying wet cosmetic treatments where the friction sliding and massaging requirements are minimal. If the paper can be used dry or is impregnated with a dry medium or is suitably rough or porous for dispensing dry powder, or perhaps less rough and using a powder substance as a dry lubricant, then they may also be suitable for frictional engagement and rubbing against skin to massage.

[0145] The method herein has benefits for applying acne treatments where it provides useful mechanically enhanced skin cleaning as it typically applies antiseptic lotions.

[0146] The coefficient of friction of the friction face of the friction tool is a design parameter of the tool and is directly influenced by the choice of materials used on the friction face, but its determination in relation to the use of this tool is experimental because it is affected also by the presence of friction modifying materials, such as powders or fluids. The classical approximation of the force of friction known as Coulomb friction is \( F = \mu R \) a mathematical relationship, where \( F \) is the friction force and \( R \) is the reaction force of the skin which is equal and opposite the applied normal force maintaining the sliding face in contact. \( \mu \) is the coefficient of friction a constant for particular conditions, \( \mu \) is a dimensionless quantity that is constant for a given set of conditions, and is determined by experiment. In mechanics, this figure matches theory to observed results and bears no relation to the actual causes of friction. It indicates the amount of friction that occurs between different combinations of sliding materials. Conventionally there are two values for \( \mu \), one for overcoming the static resistances and dynamic (otherwise referred to as the kinetic), which is usually a lower figure and is that required to maintain sliding. The symbols for these are \( \mu_s \) for static values and \( \mu_k \) for kinetic respectively.

[0147] The method determining the coefficient for the friction face involves the steps of first pressing the friction face against the skin (first force) to induce reaction force \( R \), and then applying a lateral force (second force) \( F \) to slide the face against skin.

[0148] In vivo frictional properties of human skin have been measured in studies of prosthetic attachments and hand grip and the following figures are quoted by way of a guide, although they do not specifically refer to the same conditions pertaining in the method, they provide a useful reference. Typical average figures are quoted by Zhang M and Mak AF of The Rehabilitation Engineering Centre, The Hong Kong Polytechnic University, Kowloon published in Prosthet Orthot Int 1999 August 23 (32) pages 135-41 as follows: “In vivo frictional properties of human skin and five materials, namely aluminium, nylon, silicone, cotton sock, Perlite, were investigated. Normal and untreated skin over six anatomic regions of ten normal subjects were measured under a controlled environment. The average coefficient of friction for all measurements is 0.46+/-0.15 (p<0.05). Among all measured sites, the palm of the hand has the highest coefficient of friction (0.62+/-0.22). For all the materials tested, silicone has the highest coefficient of friction (0.61+/-0.21), while nylon has the lowest friction (0.37+/-0.09).”

[0149] Our own tests showed a widespread range of variation of \( \mu_\alpha \), due firstly to variations of the skin itself and secondly to the environmental conditions pertaining during the tests. For example, friction tests on the male human face showed a huge spread ranging from 0.7 to 1.8 for \( \mu_\alpha \) due to beard stubble that mechanically engaged (interlocked) with the friction face. Thus friction was anisotropic because the beard grows generally downwards (nap), thus friction was greater on the upstroke against the nap. These figures refer to a water wetted beard.

[0150] It is difficult to precisely define the skin condition as either dry or moist, and this influences \( \mu_\alpha \). In practice, the skin conditions are likely to vary over an area being treated with the tool; therefore, the figures quoted are a guide for \( \mu_\alpha \) based on the assumption that average skin conditions will have some slight amount of moisture present but the skin feels dry to the touch.

[0151] From our test the average figure for \( \mu_\alpha \) for a dry friction face of non-woven fibre in sliding contact with dry female skin appears to be about 0.5. Tests with a range of friction face materials indicate a figure averaging above this is desirable for the tool.

[0152] If the reaction force \( R \) spreads over too large an area frictional engagement becomes less uniform and the tool becomes less effective. Thus the area of frictional engagement must be sized to uniformly exercise a useful large area, but not so large that insufficient or inconsistent frictional engagement occurs.

[0153] The outline shape of the friction face on the friction pad is bounded by dimensions in the x and y directions, which define the plane of the friction face and the friction pad has thickness in the z direction, which is normal to the plane of the friction face. Typically the thickness of the friction pad ranges from 25 microns to 25 mm. The support face is usually made slightly smaller than the friction pad, so that it provides slightly less support towards the edge of the rubbing face, which makes the rubbing face softer at its edge. If the support is still like a container, for example a moulded plastic container, the support face shaped in the third dimension—the z direction with a radius or chamfer around the edges of a flat or
slightly domed face. The chamfered edge provides less support for the friction face at its edge making the edge more deformable (less stiff).

[0154] The shape of the support body and the support provided may be equally stiff in both x and y directions, or, the support may provide more support in a first plane and less in a second plane, the arrangement adopted depends on the application. For use on large limbs, a blade like tool is preferred because it provides a larger contact area, allowing longer sweeping/sliding action somewhat similar to the action used in plastering a wall or ceiling, this blade like tool having a friction face that is stiffer along its longest axis to improve control, the support conveniently with folded card.

[0155] The tool’s friction face is sized to apply effective massage within the time it takes to apply and work in a typical shaving formulation, which was on average measured at about 1 minute to apply and work in. By iteration it was found that to ensure the area can be covered and massaged adequately during shaving the area of frictional engagement between friction face and the stubble on the face needs to be at least 2%, optimally 3% ranging up to 10% or more of the superficial area to be treated. Here the word superficial means a two dimensional estimate of an area on a complex three dimensional shape like a human face. Typically the superficial area of the bearded part of the face when shaving is about 425 cm² thus 2 to 3% frictional engagement requires 8.5 cm² up to 12.75 cm² contact with a friction face on a tool, thus a tool area of about 14 cm² shaped as a flat regular ellipse with soft edges would be appropriate to give good access around features of the lower face.

[0156] In the case of applying a moisturiser, for example after shaving and to the entire face, when a different larger tool is used because the area to be treated is larger. In such an application it is estimated that the superficial area treated is 65% more than for shaving which approximates to 750 cm², and applying the 2 to 3% rule gives the average area of frictional engagement between 15 and 21 cm². A convenient sized tool was found by experiment to have a friction area of about 45 cm². The optimum friction face shape was found to approximate to a heart shape (as appears on playing cards), with a narrowed end with rounded point for accessing the skin around the eyes and the nose and a broad beam for treating the large areas of the face and neck, and with a soft edge.

[0157] Experience showed when massaging the human face, an average numerical ratio between the area of uniform frictional engagement in mm² divided by the contact circumference in mm should be preferably greater than 5:1 and most preferably greater than 10:1 to minimise the edge contact transitions when the treatment is applied rapidly (and vigorously) within a period of the order of 2 minutes. These ratios are averages, the actual ratio can vary beyond these limits when rubbing around the eyes for example. The ratio also varies with the depth of the subcutaneous soft tissue across the face, deep soft tissue requires a larger area of frictional engagement to ensure the induced lateral stress fully exercises the deepest tissues.

Additional Description of Cosmetic Method

[0158] Skin exhibits visco-elastic properties, which behaviour is one in which hysteresis is seen in the stress-strain curve as stress relaxation occurs. Practically, this means that upon moderate stretching (stressing) skin initially expands elastically and if immediately relaxed returns to very close to its original shape/size, but the longer stress is maintained the less it springs back, if it becomes permanently extended it is said to be 'strained'. Therefore to avoid distorting the skin it is important that no area on the treated skin be subjected to uniaxial stress alone, either steady or varying otherwise permanent distortion occurs. If the direction of the second (lateral) component of the vector force is made to alternate it reverses the direction of sliding and applied lateral stress, and if the resultant distances traveled in each direction are made equal, successive equal and opposite strained deformations cancel.

[0159] For small deformations such as those produced with the tool described hereinbefore, mammalian skin displays near linear visco-elasticity. These deformations can be visualised with the help of a mechanical model proposed by James Clerk Maxwell of a spring in series with a damped dash pot and is therefore described as a Maxwell material. Any small extension in a Maxwell material is reversible over a short time, hence by alternately stretching and compressing the tissues at the same rates in opposite directions the effects substantially cancel and there is minimal net change in shape, providing the deformations are made one immediately followed by the other. Beneficial adaptive changes are induced by subjecting the skin to low to moderate cyclical alternating strain, because the repeated exercising helps train the load carrying fibres in both the cutaneous and subcutaneous tissues layers to better respond to internal muscular applied deformations. This improves the appearance, elasticity of the tissues and their dynamic response in the direction of the applied stress as well as biological functions such as vascular function and lymphatic drainage.

[0160] Frictional engagement between the friction face and the skin is determined by one or more of the group comprising:

[0161] 1. Intermolecular forces acting between friction face and skin
[0162] 2. Mechanical interlocking due to deformations of skin and friction face,
[0163] 3. Mechanical interlocking of appended hair with the friction face,
[0164] 4. Viscous shear within materials placed between the friction face and the skin.

[0165] Upon application of the vector force, first vector component causes static frictional engagement then upon application of the second vector component sliding occurs which is described as kinetic or dynamic friction. All the above listed factors influence both static and dynamic friction.

[0166] The intermolecular forces provide grip which is greatest with materials such as rubbers and in particular thermoplastic urethanes and similar materials. Mechanical interlocking occurs as resilient slightly softer skin is forced into the roughness of a stiffer friction face. If hair is present on the skin and the friction face is fibrous then the hairs engage with the fibres to cause frictional resistance. Both the static and dynamic levels of friction are affected by the presence of a material at the sliding interface between the friction and the skin. The materials may be liquids or dry fine powders. If wet it may be due to natural excretions from the skin or to a topically applied compound, the compound as well as having tribological characteristics also having a functional cosmetic purpose and it is the benefits derived by combining the application of these functional cosmetic lotions with massage done in the time it takes to apply the cosmetic lotion that is a preferred feature of the method of this invention.
The topical application of fluid at the sliding interface may reduce friction if it acts as a lubricant; or it may raise friction in which case it acts as an anti-lubricant. The term topical describes a fluid introduced locally to the skin surface. The fluid may for example be a compound created for a personal care purpose such as cleaning or colouring (changing the colour) of the skin by simply rubbing the formulation onto the skin. However, its effectiveness is likely to be improved by the method described herein because the mechanical agitation provided by the sliding friction improves wetting and absorption and potentially will drive chemical and biological interactions.

The viscosity of the introduced fluid compound may vary from a thin free flowing liquid up to a thick gel or it may beneficially be thixotropic, which means it thins as it is deformed. The compound may also contain small particulate that may or may not include mild abrasive, providing the abrasives are fine and do not damage the skin during exercise. It is preferred that at the microscopic level a thin film of fluid a few microns thick should separate the friction face from the skin at the sliding interface to protect the skin.

The behaviour of thin films under the stress of sliding is described in Tribology (the science of lubrication) as elastohydrodynamic separation, it means that there remains a continuous film of material separating the friction elements on the friction and the skin during frictional sliding; therefore the skin is actually deformed through the separating film. This thin film provides sufficient shear coupling with the skin to remove dirt and dead skin platelets.

The pressure exerted on the film can become significant at sliding contacts and these high pressures are sufficient to drive fluid into and through microscopic damage sites in the stratum corneum from where low molecular weight elements more easily diffuse into the dermis. Also, the compound is forced down hair and sweat pores and penetrates the dermis. Thus during the method, the sliding improves topical wetting and adsorption on the microscopic scale. This improves chemical absorption into the dermis, which improves the function of chemical compounds formulated to chemically interact with cutaneous tissue and potentially subcutaneous tissue.

In embodiments, the method includes the topical application of chemically active cosmetic compounds whose functions are improved by the friction induced cutaneous and subcutaneous exercise.

Some examples of the function of the introduced fluid compounds are, cleaning compounds, exfoliating compounds, depilatory compounds and conditioning compounds such as moisturisers, anti-aging compounds, shaving gels and soaps, and antiseptic cleaning compounds for the cosmetic treatment of skin disorders such as acne.

Compounds containing soaps or oils tend to reduce friction whereas water tends to raise friction, especially with rubbery friction materials. Of particular interest are materials that change the frictional properties between the friction and skin during extended rubbing. For example many emulsions separate during rubbing and water evaporates causing the viscosity and viscous shear levels to rise, in some case making further sliding impractical.

Another example of this is applying a shaving lubricant in the form of soap where the soap is applied to the friction face by first impregnating it into the friction pad herein. The beard stubble engages with a fibre body and the friction is high, but soap has a low coefficient of friction and this immediately lowers the friction making sliding possible, then as the soap dissolves more friction elements are exposed and the friction rises influenced by the propensity of the unshaven stubble hair to interlock further with the rough (net-like) friction face. It is as a result of hair interlocking that the facial tissues and especially muscles are very well exercised leading to an improvement in facial appearance due to hypertrophy after shaving. The high friction due to interlocking also has a beneficial effect on plucking out ingrown ends of curled hairs. As sliding continues, the hairs become thoroughly worked and wetted and soften leading to a very satisfactory smooth shave. Shaving lubricants used with the friction pad may be either applied separately or through the porous friction face. The lubricants may be either lathering or non-lathering and preferably incorporate surfactants.

The thickness of the cutaneous layer on the human face is fairly constant at between 1 and 2 mm whereas the subcutaneous layer varies widely from less than 1 mm millimetre on the human forehead to more than 10 mm on the lower facial cheeks. Thus, when exercising the subcutaneous layer it is important that the gripped area of cutaneous tissue is large enough to fully stress the deepest soft subcutaneous material.

Upon applying the vector force and sliding, the skin under the tool is compressed and relatively lightly stressed laterally while the deeper tissues are strained laterally; and, concurrently the skin adjacent to the tool is strained laterally while its underlying tissues are mainly stressed.

This complex behaviour is unexpected and is governed by the size and in particular the uniform nature of the frictionally engaged area.

The area of frictional engagement must be large enough to effectively grip the cutaneous layer uniformly, which in turn stresses the subcutaneous tissues sufficiently to strain these either by stretching or compressing.

The minimum area of frictional engagement is determined by the depth of the soft tissue at any point being treated, but because of the variability of this depth it is difficult to reliably specify. Experience has shown that the ratio of contact area with the perimeter or circumference of the frictionally engaged area provides a useful guide to the effectiveness of the treatment applied to the subcutaneous soft tissues. In embodiments, the higher the ratio of the contact area divided by the circumference of the friction contact area the better the tool works and the figure should be greater than 5 and preferably about 10.

The term resistance exercise as used herein after means stretching and compressing against a fixture as occurs when contracted muscles are repeatedly stretched under load to improve their efficiency as occurs in bodily muscles during weight training.

By alternately straining the fibrous visco-elastic tissues of both the cutaneous and subcutaneous as in resistance exercise, elasticity is improved by optimising load sharing between fibres therein, during which fibres tend to realign and unfavourably orientated fibres that limit elasticity in a particular direction break. Thus by progressively stretching and compressing, the elastic range of the tissues is raised in the direction of exercise, which is preferably also in the direction of contraction of nearby muscles.

Experience has shown that quick effective massage of the face can be applied within the period it takes to apply a cosmetic lotion providing a large frictional contact area is employed, and this is impractical with any combination of
human fingers alone (the most commonly used friction applicator tools). When using fingers the area and contact pressures is more variable than with a tool as described hereinafter. It was observed that sometimes the palm of an open hand is also used to apply lotions over large bodily areas. The fingers and palm also result in less uniform coverage than with said tools, hence using said tools speeds up massage.

[0183] After a period of about 10 days of regular application of the method the soft tissues were found to fit the skeletal frame of the face better improving face shape and with improved dynamic response, which means less slack and better response to jaw movement when speaking or smiling. Voids around the inside of the aural cavity (mouth) are reduced. The exercised muscles exhibit tightness, slackness of the jaw sockets is reduced noticeably when chewing. The exercise and training also improves the skins vascular functions and metabolism. Lymphatic drainage is improved; adipose fatty deposits in connective tissue are reduced. The reflectivity of the skin is improved by the tendency towards parallel alignment of the outer fibres of the dermis.

[0184] The condition of connective tissue is important because it supports the skin and anchors it to muscles or the skeletal frame and therefore contributes significantly to the smoothness and appearance of the skin. It also carries insulating fat that can become excessive if not regularly exercised. Relatively little was found in the literature concerning the biomechanical behaviour of connective tissue. Connective tissue are said to be composed of three classes of bio molecules, structural proteins (collagen and elastin), specialised proteins (fibrillin, fibronectin and laminin) and proteoglycans. The subcutaneous layer is said to comprise a loose matrix of fibres interspersed with significant fatty deposits. Mechanically, this appears to behave like a soft sponge that supports and can stretch with the skin. As this spongy matrix is exercised (stretched and compressed during the method), so it tends to exude excess fluids and/or fat from its structure.

[0185] Scar tissue can be an overgrowth of connective tissue and it was found that initially both scars and flat moles became slightly more prominent for a few days before becoming significantly less prominent after regular use of the method for more than one month.

[0186] While the common method is to use the tool with sliding strokes, the tool can be used for non-sliding deformation, for example when treating very thin skin. Non sliding strokes must be long enough for their deformation to reach and deform into the subcutaneous and muscular, thus their actual length will depend upon the depth of subcutaneous tissue at any point. Non sliding applications are useful around the eyes and lips where the skin is particularly thin and there is a risk of injury to the eye by inadvertent contact. Non-sliding massage with the frictional rubbing method described herein is conveniently done with small powered tools with side support pads.

[0187] The minimum sliding stroke length depends upon the shape and size of the area to be treated and the depth of the soft tissue in any given location. For example on the legs sliding strokes can be 150 mm or more, done with long tools whereas on the face across the cheeks and up to the forehead they average 50 mm, around the mouth 20 mm and close to the eyes they may average as little as only 5 mm or less. Non sliding deformations range from 10 mm down to 1 or 2 mm, depending upon the depth of subcutaneous soft tissue. When treating the face it is important to minimise stress inducing edge transitions, an edge transition being an edge on the tool passing over a given point, therefore it is preferable to maximise the length of the rubbing face so the average length of the strokes are less than 50% of the length of the tool. This rule does not necessarily apply to non-facial areas.

[0188] The velocity of sliding and the resultant rate of deformation of the skin are important because skin is visco-elastic and when subjected to a sudden impact or extension it may not have time to stretch elastically and instead shears or tears. Thus the rate of change of applied stress must be such that the skin can elastically respond to it and tolerate it without trauma. Similarly the tool must decelerate without causing trauma or physical damage.

[0189] Providing the tool velocity changes at a rate that is within the elastic response time of skin, the tool being in frictional engagement actually supports the skin in direct contact with the tool during lateral acceleration and deceleration, in both static (non-sliding deformation) and dynamic (sliding deformation).

[0190] The skin around the edge of the static or sliding tool may experience high shear forces during acceleration and declaration. The tools are designed to have progressively less frictional contact towards their edge by making them softer or more deformable at their edge to reduce the risk of shear.

[0191] The cosmetic method provides for improving bodily shape and appearance of well-being. The term ‘Bodily shape’ means the shape of some parts of a mammalian body, especially in relation to the human face, whereas the term ‘well-being’ means a general healthy appearance, which includes surface smoothness, texture, colour and reflectivity of the skin. It also includes the lack of spots, rashes and other features that can be detrimental to healthy appearance. For the purpose of this specification the term acne is used to describe a series of cosmetic blemishes on the skin.

[0192] While the tool and method is potentially useful for treating most areas of a mammalian body, it appears to be particularly beneficial when used around the human face and neck. On the face there are many muscles that are coupled to and are visible through the skin and these control the facial expressive reactions, such as smiling or frowning and the tool and method has been shown to be highly beneficial in improving these features.

[0193] The size and condition of the facial and neck muscles declines with age and cause cosmetic problems due to slack wrinkled skin especially around the lower face and neck and the tool and method has been shown to reduce these problems.

[0194] For areas such as the chest, back and limbs like arms, hands and feet there is less muscle attached to skin, therefore the benefits of friction-induced subcutaneous exercise are less evident.

[0195] The tool and method is useful for exercising irregular shaped deposits of adipose fatty tissue attached to the hypodermis, (the subcutaneous tissue immediately below the
skin), which occurs in excess for example at the back of some female legs and is often referred to as cellulite.

By way of a guide the following figures indicate average forces and areas of frictional engagement measured while treating various areas of a human body. In treating human lips, where the cutaneous layer is thin compared with the rest of the face, the reaction force R results from applying a force in the range 0.01 to 0.3 N normal to a sliding interface area of between 100 and 500 mm², which is typically the area of a circular lipstick dispenser. In treating the female face, the reaction force R results from applying a force in the range 0.01 to 4.00 N normal to a sliding frictional engagement area of between 700 and 2500 mm².

In applying a shaving lubricant to a male human face, the reaction force R results from applying a force in the range 1.00 to 12.00N normal to a sliding frictional engagement area of between 850 and 1275 mm².

In treating a male neck and body the reaction force R results from applying a force in the range 1.00 to 10.00N normal to a sliding frictional engagement area of between 1000 and 5000 mm².

The range of typical contact pressures experienced during trials are calculated and shown in the following table:

<table>
<thead>
<tr>
<th>Area</th>
<th>Pressure</th>
<th>Incision</th>
<th>Max Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female lips</td>
<td>0.01</td>
<td>0.04</td>
<td>100</td>
</tr>
<tr>
<td>Male lips</td>
<td>0.01</td>
<td>0.04</td>
<td>100</td>
</tr>
<tr>
<td>Male face</td>
<td>0.1</td>
<td>4</td>
<td>700</td>
</tr>
<tr>
<td>Female face</td>
<td>0.01</td>
<td>6</td>
<td>1000</td>
</tr>
<tr>
<td>Male neck/body</td>
<td>1</td>
<td>10</td>
<td>1000</td>
</tr>
</tbody>
</table>

The overall contact pressures at the frictionally engaged sliding interface will therefore range form $3.33 \times 10^{-5}$ to 0.01 N/mm².

Material of the friction face should be non-aggressive to prevent it damaging the stratum corneum during sliding. The stratum corneum is the outermost layer of skin comprising of 12 to 15 layers of flat platelets of dead and dying keratin material collectively between 0.07 and 0.12 mm thick. These platelets are joined with flexible lipid material that seals the outer layer. The platelets naturally shed.

The stratum corneum may be damaged if the friction surface has abrasive materials thereon that are capable of deep cutting or if there are sharp scraping edges that might start to penetrate somehow. Therefore the surface of the friction pad can be sufficiently abrasive to moderately exfoliate but not so abrasive as to penetrate and damage to the skin while exfoliating. By way of a guide the friction should cause only mild inflammation, barely pinking the surface of the skin after 2 minutes moderate rubbing.

To treat a large area using a reciprocating action, which means alternating back and forward, the tool should be progressively moved slightly sideways to traverse the areas. On the face and neck the muscles are mostly aligned vertically, running down over the forehead and across the cheeks and under the jaw and down and across the neck. The alignment around the mouth and below the nose and around the eyes becomes very complex and these tend to be laterally orientated. During rubbing with the tool the friction face should follow the muscle alignments generally being slid in the up down direction on the face except for the lower face where it can be applied in a semi-circular alternating rubbing motion. It is beneficial to rub along and across deep crease lines also.

The term cutaneous as used herein describes skin, an organ of a mammalian body and matters relating thereto, existing on, or affecting the skin. A cosmetic cutaneous reaction means in relation to this invention, an increase in metabolism, lymphatic or vascular activity such as blood supply to the dermis due to exercise the result of deformation and/or sliding contact with a tool, each of which can improve cosmetic appearance.

The term subcutaneous as used herein describes a layer of soft tissues immediately under and supporting and coupled to the cutaneous layer. A cosmetic subcutaneous reaction is understood to mean, in relation to this invention, the effect of stresses, deformation and exercise of the hypodermis (that part of the subcutaneous layer immediately under the dermis) and muscle and connective tissue associated therewith, each of which can improve the shape and cosmetic appearance.

The overall contact pressures at the frictionally engaged sliding interface will therefore range form $3.33 \times 10^{-5}$ to 0.01 N/mm².

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There are now described several embodiments of the invention, with reference to the accompanying drawings.

FIG. 1. A schematic diagram in cross section of a friction tool herein frictionally engaged with skin, showing a vectoried force applied thereto to laterally exercise mammalian cutaneous and subcutaneous tissues.

FIG. 2. A magnified view in cross-section of a piece of skin with an arrector pli muscle supporting a follicle carrying a hair projecting therefrom that is frictionally engaged with a section of a lofty non-woven friction pad herein.

FIG. 3. Illustration of a friction pad herein on a support with friction face engaged with skin, the gripped skin stressing a subcutaneous muscle.

FIG. 4. Illustration of a friction tool herein being used to exercise facial tissues while applying pre-shave lubricant or after shave moisturiser.

FIG. 5. Illustration of a bladed friction tool herein being used to exercise cutaneous and subcutaneous tissue for anti-cellulite treatment.

FIG. 6. Illustration of a stick form friction tool herein, in which are stored friction pads impregnated with a compound, said pads are transferred one at a time onto the lid for use, then after use they are detached and discarded.
FIG. 7. Illustration of a friction tool herein with fluid storage and dispensing means.

FIG. 8. Illustration of a powered friction tool herein with supporting friction faces that limit the area over which the skin is stretched.

FIGS. 9A to 9D. Schematic illustrations in cross section of alternative friction tools herein when frictionally engaged with skin, with a vectored force applied thereto to exert a sliding skin lateral.

FIG. 10. Perspective view of the friction tools herein of FIGS. 9A and 9B held by a hand of a user.

FIG. 11. Perspective view of the friction tools herein of FIGS. 9C and 9D held by the hand of a user.

FIG. 12. A mesh or net-like surface layer herein being rubbed against and interacting with typically 2 days of unshaven male beard stubble.

FIG. 13. A mesh or net-like layer formed at the surface of a friction pad herein showing unshaven facial hair engaging therewith when rubbing.

FIG. 14. Cut-away view of a friction pad of lofty non-woven fibre web herein with net like layer of fibres at rubbing face bonded with array of binder blobs.

FIG. 15. A variation of the pad of FIG. 14 with bristle like vertical columns added.

FIG. 16. A variation of the pad of FIG. 14 with reinforcement net added to friction face.

FIG. 17. A variation of the pad of FIG. 14 with bristle and net features combined.

FIGS. 18a-18c. The manufacturing steps for the pad of FIG. 14 or 15.

FIGS. 19a-19c. The manufacturing steps for the pad of FIG. 17.

FIGS. 20a-20d. Alternative manufacturing steps for pad of FIG. 14 or 15.

FIGS. 21a-21c. Alternative manufacturing steps for a variant of the pad of FIG. 16.

FIGS. 22a-22c. Alternative manufacturing steps for a variant of the pad of FIG. 15.

FIGS. 23a-23c. Alternative manufacturing steps for a variation of the pad of FIG. 17.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram showing the tool 1, 2, 3 herein rubbing against skin 4, 5, 6, 7, 8 in which the layers are presented in symbolic form and not to scale. Shown are a friction pad 1, carrying friction face 2, the friction pad 1 mounted on a support 3. The friction pad 1 comprises a resilient material like a lofty non-woven fibre body defining a friction face 2, which is provided with a net-like layer (not visible in this profile). The sinusoidal pattern symbolically represents skin 4 being regularly deformed by a net like layer at friction face 2 as it is pressed against and slides in frictional contact with an outer layer of mammalian skin 4 so as to evenly grip the skin and laterally displace its cutaneous layers 5 and 6 and thereby stress and exercise the subcutaneous layers 7 and 8 against a base anchorage 9. Vectors 10 to 18 shown inserted on each relevant layer show how the forces are transferred.

Cyclical (reversing) external forces are applied in directions 10 and 11. 10 is the first force applied in the first direction for the first half cycle followed by the second force 11 applied for the second half cycle in the second (opposite) direction, both applied to the support layer 3 by means of holding the tool that is not shown. Vectors 14, 15 show the internal forces resulting from externally applied force 10 being transmitted through the tool 3 and 1 to the friction interface 2. Forces 16, 17 and 18 show the reaction (resistance to deformation) to force 10 within the cutaneous and subcutaneous layers 6, 7 and 8, illustrating how energy (force 10) applied to the tool is dissipated by doing work within and between the cutaneous and subcutaneous layers within the diagram. Vectors 14, 15, 16, 17, 18 reverse when force 11 is applied.

FIG. 2 is a simplified cross section view (not strictly scale) of mammalian skin with a hair shaft 26 mechanically and therefore frictionally engaging with laterally orientated fibres 32 of the friction face, (shown in cross section and depicted approximately ten times larger than actual). Friction face fibres 32 are shown pressing against face...
33, this deforms the skin inwards at 33 to form an interlock that resists lateral sliding. Hair 26 frictionally engages with the fibres about region 34 and resists sliding. Molecular attractions between the materials of the friction fibres 32 otherwise referred to as friction elements and where they touch hair or skin and these attractions also resist sliding. Upon reciprocating sliding the fibres cutaneous layers 22, 23 and 24, and subcutaneous layers 27 and 31 are exercised as shown in FIG. 1.

[0238] The stratum corneum 21 is the outer horny surface of the epidermis 22, which is the outermost layer of the skin. The epidermis 22 is between 0.07 and 0.12 mm thick and consists of up to 15 layers of flat platelots of dead or dying cells of keratin 23, joined with a flexible lipid (too small to be discernable on a drawing of this scale). During rubbing with fibres 32, loose platelots are removed. Lipids act like flexible glue like seals holding the keratin platelots together and creating an elastic barrier layer that keeps out dirt and unwanted fluids and protects the dermis 24, the living part of the skin.

[0239] The dermis 24 is a fibrous leathery mass typically about 1 mm thick in older skin but up to 2 mm thick in young skin. The dermis 24 consists mainly of fibrous collagen, a protein that comprises 70 to 80% of the dry weight of the skin and gives the dermis 24 its mechanical and structural strength. Collagen is relatively inelastic. Elastin makes up the balance and provides the skin with its elastic properties. Elastin fibres can extend 50% and recover without permanent elongation. Combined these give skin visco-elastic properties.

[0240] FIG. 3 illustrates the friction tool being used on a simplified cross section through tissues in which there is a single muscle 43 shown linking the hypodermis 44 to a bone 45. The diagram shows a friction face 36 on a friction pad 37, in turn supported by planar support surface 49. The friction face 36 of the friction pad 36 has a net-like surface layer (not clearly visible). The friction pad 37 with friction face 36 thereon is pressed against skin (equivalent to first vector component force 12 in FIG. 1), in direction of arrow 38 to form a frictional engagement at interface 39. An external lateral force 41 (equivalent to second vector component force 13 in FIG. 1) is then applied to slide the friction face in the direction of arrow 40 that is parallel with skin.

[0241] The frictional interface 39 is shown waivy (sinusoidal as in FIG. 1) to represent the friction face 36 deforming the skin 42 and thereby forming many wavy high friction interlocks between the friction face 39 and deforming skin 42. Friction pad 37 extends beyond the planar support 49 at the edge 37A providing a soft edge to minimise stress transitions in the skin during sliding.

[0242] If the muscle 43 is in compression (internally tensed) in the direction of arrows 46 and an external tensile stress is applied by the sliding motion of friction face 36 in direction 47, muscle 43 is stretched in the direction of arrow 47. The stretching exercises the muscle, reacting via the tendon 48 that is firmly anchored to the bone 45; this is known as a resistance exercise.

[0243] FIG. 4 illustrates how a first friction pad 36 of FIG. 3 is attached to a hand held first tool 82 said pad 50 carrying a net-like layer (which is not visible) and used to apply a lotion, such as a shaving formulation to the lower face by reciprocating the rubbing, generally in directions 51, 52, 53, 54 and 55. When applying pre-shave lubricant, the friction tool mechanically engages the hairs and skin as illustrated in FIG. 2 and lifts them by pushing and pulling. It thereby stretches and compresses the skin and the muscles attached thereto as illustrated in FIG. 3 to exercise the facial expressive muscles. Friction tool 82 is here shown applying a chemical formulation, such as shaving lather to the chin by sliding in the up/down direction shown by arrow 51. Arrow 52 shows the direction of sliding for the side burns. Arrow 53 shows the direction for treating the cheeks and 54 around the mouth. Arrow 55 shows the motion under the chin and down the neck. Because there are many overlaying minor expressive muscles around the lower part of the face, and these are orientated in various directions, this part of the face may be rubbed in various directions with the tool 82 providing on average the direction of each stroke is reciprocated (alternated). All the facial muscles benefit from the exercise because, they are mainly joined direct to the skin and can be seen bulging through the skin, which influences face shape and appearance.

[0244] Referring back to FIG. 2, this shows the hair 26 actually reaches through the cutaneous layers 22, 23, 24 and down to the subcutaneous layer 27. Thus the deformation forces when sliding against hair in FIG. 4 tend to be transmitted via the hair follicles straight into the subcutaneous layer 27, 31 and there is less deformation in the cutaneous layer 22, 23, 24 than might be expected and this provides very beneficial subcutaneous exercise. In FIG. 4, the more vigorous the sliding and the more extensive the area treated the greater the improvement in appearance. As a result of this exercise the face shows improvement because the subcutaneous expressive muscles are expanded, giving the appearance of lifted cheeks, reduced deep crevices and reduced jowls and neck flab. The firmup muscles cause the skin to feel firmer and tighter to the touch overall. These effects start to be noticed after the first few shaves, thereafter a steady improvement occurs up to between fifteen and twenty consecutive shaves, even up to fifty shaves, depending on how effectively the exercise is applied, after which the muscles are maintained in an exercised state providing the process is repeated every other day.

[0245] It was found beneficial to frictionally exercise the entire face while also applying a post shave moisturiser, including the forehead, the nose and around the eye sockets done with a blade like second friction tool carrying a resilient friction pad, such as a sponge or lofty non woven friction pad with a net-like layer, similar in shape to that illustrated in FIG 5. This tool is highly conformal and readily follows the curvature of the face, and reaches into recessed areas. This second tool is also eminently suitable for treating a female face by sliding along the arrow directions 51, 52, 53, 54, 55 as well as the additional arrows 81 to fully treat the entire face.

[0246] FIG. 5 by way of another example illustrates a similar method of treatment for exercising subcutaneous tissue applied to a female leg 78 with a large area blade like tool with handle 57 coupled to a stiff support 56 carrying a non woven friction pad 77, the rubbing friction face 59 has a net-like top layer (not clearly visible) and projects beyond the support 56 to give the tool a soft edge and thereby minimise shear stress in the skin near the tool edge during sliding. The tool is shaped and used rather like a plasterser troll to and is used to slide in alternating directions as shown with arrow 58. The tool blade 56 must be stiff in at least one axis preferably along the axis of the handle 57 to allow sufficient contact pressure to be applied. The blade tool may carry a second face for rubbing on its reverse side.
FIG. 6 illustrates a tool for implementing the method in which a container 60 is sized and shaped for gripping by hand, roughly 35 mm diameter and 100 mm long, in this tool the container lid 63 that constitutes a support onto which the friction pad is attached.

A tubular plastic holder 60, described as a propell/repel stick holder and is based on a design used for deodorant sticks. The moulding may be round as shown 60 or it may be oblong or elliptical or any other practical mouldable and hand holdable shape. The moulding has a rotary knob 61 coupled to an internal screw (not shown) and upon turning 61 the contents stored within the tool body 60 are forced upwards. A column of pads 61, each of which in use serves as a friction pad, made with an absorbent material such as non-woven fibres with a net-like layer thereon. The friction pads may be dried dry or pre-impregnated with a compound such as shaving lubricant, for example either a gel or soap. A cap 63 has means of attaching a friction pad, such means may be a contact adhesive or preferably an array of hooks 64 that engage with loops of fibre within a body 65.

The method for using the tool is to remove the cap 63 from the body 60, turn knob 61 to expose a new body 62, invert cap 63 and press the array of hooks 64 against the new friction pad 62 to engage it. Replace the cap 63 onto the body 60 with new friction pad 65 on top of the cap. The tool may then be used as shown in preceding example FIG. 4.

FIG. 7 illustrates a further example of a tool for implementing the method, the tool having a more rugged long life friction face 70 with net-like top layer profile (not clearly visible) that is moulded into or attached onto the cap 71 by for example adhesive.

The tool comprises a cover 72, covering a fluid storage cavity within body 73 and a cap 71 with a friction pad with a friction face 70 thereon. In use the cap 71 with friction pad 70 thereon is removable from the support 72 and fluid such as for example a shower gel or shaving lubricant is dispensed from orifices 75 in cover 72 onto a friction face 70 by turning knob 74 to force the fluid out of slots 75. The friction pad 70 on cap 71 is then slid down over support (cover) 72 and retained; the tool is used to vigorously rub against the skin, generally as described in the earlier examples and with reference to FIG. 4. For other applications such as shaving legs or applying shower gels or other cleaning and conditioning treatments, the outside areas 76 on the tool body 73, which is used primarily as a holding area, may also be partly or fully covered with a friction surface 76 and these are useful for applying treatments to large areas of skin such as legs. When friction areas covered with lofty non woven friction pad carrying a net-like layer on the container walls 76 (the net like layer not visible at this scale) are also used as rubbing faces then for practical purposes fluid must be dispensed from orifices 75 directly onto the skin. The friction face must be cleanable by rinsing of hygiene purposes.

An alternative arrangement is to incorporate the dispensor orifice 75 into the friction pad 71 either adjacent to or within the friction face 70, but this requires a one way valve be used at the orifice to prevent contamination from the friction face 70 entering the storage cavity during rubbing with friction face 70. In such an arrangement the holdable body 73 acts as the support.

FIG. 8 illustrates a motorised vibrator with tubular casing 90, 91 sized and shaped to be hand holdable. The aim of this tool is to exercise subcutaneous tissue with a friction face 92 that grips but does not slide against the skin, which is beneficial when treating subcutaneous tissue under areas with very thin skin, such as lips and delicate skin under the eyes. The casing 90, 91 houses a small motor or vibrator (not shown) that couples to a second body 101 upon which is positioned a friction pad, a first body 102, which friction pad is resiliently deformable, and which friction pad 102 defines a planar friction face 92. The planar support face 102 is rounded at its edge to provide a graduated soft edge 103 to friction face.

In use the friction face 92 alternates in the direction of arrows 93 in the first half cycle and 94 in the second half cycle. The alternating friction pad 102 with friction face 92 thereon is positioned between two static pads 95 and 96 that are fixed to the case 90 and acts as supports during use. The distance of travel of 93, 94 is equal and opposite and is preferably adjustable. In use, case 90 is positioned normal to the skin surface and pressed against the skin to position the friction face 92 on the friction pad 102 against the skin with a first force 97, which first force divides between friction face 92 and pads 95, 96. As the friction pad with first face 92 thereon alternates between pads 95 and 96 the skin is sequentially stretched and compressed against the two static pads 95, 96 and the cutaneous and subcutaneous tissues under 92 and between 95, 96 are exercised as illustrated in FIG. 1. The edges of support pads 95, 96 and friction pad 102 and friction face 92 are shaped with a radius 103 to minimise sheen stress transitions within the skin as directions of the applied stresses 93, 94 alternate.

FIGS. 9A to 9D and 10 and 11 illustrate distinct variants of the friction tool herein: FIGS. 9A and B are schematic cross section diagrams, FIG. 9A shows a side view of a stick like tool with an elliptically shaped friction face (not evident from the projections shown) and FIG. 9B shows the end view of the same tool. FIG. 10 shows how this tool is held in use, thereof. FIG. 9C is a side view of a blade like tool with an arrow head or heart shaped friction face. FIG. 9D shows the end view of this tool, FIG. 11 shows how this tool is held.

FIGS. 9A to 9D are schematic diagrams showing how similar forces are applied with different tool constructions each carrying similar friction pads with net-like layers thereon. FIGS. 9A & B shows a stick like tool as previously illustrated in FIGS. 6 and 7 for applying face shaving lubricant and FIGS. 9C and 9D show a blade like tool for applying post shave lotion or cosmetics to the face that is of similar shape but smaller than that previously illustrated in FIG. 5 for applying lotions to a female leg. The diagrams illustrate the applied force vectors and use symbolic springs and dampers to indicate the visco-elastic responses of cutaneous and subcutaneous tissues when the tools are held, pressed against and slid over skin as shown FIGS. 10 and 11.

Each tool is provided with a friction pad 201 with friction face 202 thereon for rubbing, and a support 203 upon which the friction pad 201 is mounted, the support 203 provides means of holding the tool. In different embodiments, the friction pad 201 comprises (A) a lofty non-woven fibre material; or (B) a compressible foam layer, each provided with a net like layer of friction-enhancing material defining a friction face. The contact area with an 'x' dimension 214 the longer axis; 215 the 'y' axis, the shorter axis and pad depth is 216. x,y.'.

It will be noted that the shape of the support 203 of each of the tool variants of FIGS. 9A and B, and 9C and D differs somewhat, but that each support 203 defines a planar support surface upon which the friction pad 202 is received.
Also, bounding the planar support surface 204 the support 203 defines upwardly curving edges 205. It will be further noted that the edges 206 of the friction face 202 of the friction pad 201 project beyond the planar support face 204 and in use, tend to curl around the curving edges 205 of the support 203 to provide soft edges thereto.

[0259] The mode of use of the tool variants of FIGS. 9A and 9C is to stroke generally in the direction of the longer axis of the friction face shown as the ‘x’ dimension 214, the length of stroke should generally not exceed the length of the longer axis of the tool, and preferably (when treating the neck) with stroke lengths should be less than three quarters (75%) ‘x’ dimension 214 and most preferably when treating the face the stroke length is less than half (50%) the ‘x’ dimension 214 to minimise edge transitions during rubbing. The force vectors 207 and 208 are essentially as earlier described, particularly in relation to FIG. 1. Additionally the force vectors 207 and 208, which operate similar to those of FIG. 1, are shown schematically aligned with springs 209 and dashes 210 to indicate visco-elastic behaviour in the cutaneous and subcutaneous layers 211. To simplify the diagram 212 shows these two tissue layers schematically as a uniform visco-elastic honeycomb.

[0260] FIG. 10 shows a variant of the ‘stick’ form tool of FIGS. 4, 6 and 7.

[0261] FIG. 11 shows a variant of the blade-like tool of FIG. 5. In both cases, the friction pads 301 of the tools of FIGS. 10 and 11 have edges 306 of the friction face with net-like layer (not visible) that project beyond the planar support face (not visible) and in that use, tend to curl around the edges 305 of the support 303 to provide soft edges thereto. The tools in FIGS. 10 and 11 are gripped to facilitate rubbing along longer ‘x’ axis of friction pads 301.

[0262] FIG. 12 shows an undulating fibrous reinforcement net or mesh layer 401 of a friction pad (e.g. of the tools of FIGS. 1 to 11) herein with bonded cross fibres 402 made by a continuous extrusion or moulding of polymeric filaments, the semi-molten filaments bonding together upon contact at crossings. The average spacing of the mesh forming rectangular void spaces 403 that are sized to allow unshaved facial hair stubble 404 to penetrate and recover after being pushed over 405 as the mesh is pressed against and slide against hairs on facial skin in the direction of arrow 406. The direction of arrow 406 is in the direction of the nap that means the average direction of hair growth. The hairs shown have also been previously shaved in this direction, as evidenced by the chambered cut end 407. As rubbing proceeds fibre 410 runs down the side of the hair wetting the sides of the hair shaft 405 and then across the cut end 411 to dislodge microscopic air pockets (bubbles) that form within the roughness on the uneven ends of the cut hairs, (because these are so small they are shown as dots in this diagram). It is believed that first the removal of these microscopic air bubbles and second the pressure wave of fluid associated with the passage of each fibre sliding across the cut surface improves adsorption because fluid (water for example) is literally pumped down between the cut cortex fibres. When the direction of sliding 406 is reversed the mesh fibres catch under the base of the stubble 409 and exert greater bending force at 409, the bending action causing damage to the hair at the point it emerges from the follicle orifice 408.

[0263] The sliding is conducted in the presence of fluid composition which lubricates the mesh/hair/skin interface and reduces friction to a level that sliding is tolerably comfortable. The rubbing of the fibre along the hair shafts tends to open the scale like covering on the hair shaft 404 allowing improved water wetting and softening of the hair. Repeated bending and pulling of the hair by these means also exercise the arrector pilis muscle in the dermis (shown as 35 in FIG. 2). This muscle reacts by contracting slightly in length and firmly, the trained muscle which surrounds the buried lower portion of the follicle tends to lift the hair off the skin and supports it by tightening the follicles grip of the hair shaft at 408, thus holding it more erect and firm preparatory to shaving. This improves the shave because the angle of cut 407 and cut length are minimised. Also detrimental bending moments that can fatigue a fine cutting edge are reduced because each hair shaft is more firmly gripped and therefore bends less during cutting.

[0264] In embodiments, a fibre meshed net as shown in FIG. 12 is placed over and bonded to a resilient absorbent body such as a sponge or a lofty non-woven fibre material body to define the friction face of the friction tool herein. In the case of a lofty non-woven fibre material body, in embodiments the reinforcement net is integrated (buried) within the net like layer of fibres at the friction face of the tools (e.g. of the tools of FIGS. 1 to 11) by means described further by reference to the following diagrams.

[0265] FIG. 13 depicts an idealized net-like layer 420 on the face of a friction pad (e.g. of the friction tools of FIGS. 1 to 11) in the form of a non-woven web for use with a friction tool. Whist the fibres 421 are depicted here in a perfectly flat highly ordered arrangement, in practice they are not flat and far less ordered save for their average density is concentrated at nodes 422 where they are bonded to form a net-like layer. The density at the space 423 between the high density nodes 422 is minimal: This is described herein as void space 423. The distribution of fibres therefore varies from a maximum at the bond nodes 422 and to a minimum at 423 their equidistant centres.

[0266] FIG. 13 also shows typically two days growth of hair 425 (0.6 to 0.8 mm long) projecting through void spaces 423 shows how relatively chaotic distribution of fibres 421 can provide useful frictional engagement with hair 425, 426, 427 and thereby provides frictional engagement with the skin.

[0267] The layer of fibres 420, 421 is shown as a single layer; however it should be born in mind that an average friction face will comprise a multiplicity of fibre layers, in the range 2 to 50, most likely 5 to 15.

[0268] If the direction of sliding is as indicated by arrow 424, which is the same direction as the hair nap 425, 426, 427, the fibre spacing is such as to allow some hairs to stand off the surface 425, 426 while other hairs 427 are pressed flat. Upon reversing the direction of the sliding arrow 424, fibres 420, 421 engage the hairs 425, 426, 427 near their base and the hairs are bent severely against the nap (natural direction of growth). Thus the friction of the tools herein is greater when sliding against the nap.

[0269] FIG. 14, shows a schematic view of a friction pad (e.g. of the tools of FIGS. 1 to 11) in the form of a lofty non-woven fibre material web 430 with loft height 431 of the order of 2.5 mm or more. A rectangular cut away section 432 reduces the pad height down to the net like layer 433 that is similar to the friction face 420 in FIG. 13. The underside friction face 433 is substantially flat, and defines void spaces 434 of sufficient dimensions to allow hair to engage during sliding as illustrated previously for hairs 425, 426, 427 in FIG. 13. The void spaces 434 sized to allow wetted hair to friction-
ally slide in and out of engagement and exercise an average 2 days growth on a mature male face. The friction face 433 (underside as viewed) is as generally illustrated in the cut-away section 432 of FIG. 14 in which fibres are bunched 439 into a net-like formation defining large spaces (areas void of fibres) 434 surrounded by fibres 439 grouped into dense nodes 435, the fibres bonded with beads 436. The fibres are also displaced inwards defining a void volume 438 each aligned with a void space (net opening) 434. Droplets of adhesive binder 436 are placed at the nodes 435 on the fibres of the surface 433 in a regular matrix so as to form twoblasts of adhesive binder 436 binding displaced adjacent fibres and retaining said fibres in a mesh-like arrangement at the friction face 433. Substantially all of the fibres are bonded at both ends 437 so as to form loops 439 between bond sites 436 at the nodes 435. The actual density of fibres within the body 430 is much greater than shown and their order will be less regular than shown here schematically. The average spacing of the fibres within the web 430 are chosen to retain shaving fluids by surface energy effects, which fluids are transferred onto the skin by rubbing prior to shaving.

[0270] The loops of binder 436 are preferably of a polymeric thermoplastic in the form of an air drying adhesive, or a UV curable adhesive or hot melt material that acts as an adhesive and can be applied by means of dispensing metered amounts from needle like tubes or small cavities in a backing plate, or a forming tool. Other means also include dipping, coining, extruding, spraying, brushing, or wiping, with or without masking as may be appropriate.

[0271] The adhesive bonds 436 may protrude slightly into the web 430 beyond the surface 433 and away from the web and thereby act as rubbing elements that rub directly against the skin during sliding. Bonded fibres 439 spanning between the bonding loops 437 are dragged across the skin during sliding, which act as catchers to catch, bend and exercise hair and skin during sliding.

[0272] FIG. 15 shows a cut-away view of a friction pad 440 (e.g. of the friction tools of FIGS. 1 to 11), in the form of a lofty non-woven fibrous web and which also may be appreciated to be a variant of that friction pad 430 of FIG. 14 and with similar height and fibre density. The friction pad 440 varies from that shown at FIG. 14 by having beads of binder 442 inserted vertically through the web to form a matrix of projecting bristle like columns 442. Fibres are actually bonded where ever they intersect columns 442 and therefore stiffen the structure of the friction pad 440. If the columns 442 are for example made with resilient binder material they add significant resilience to the depth 444. The rubbing surface 445 is provided with void spaces 446 and void volumes 447 identical to 434 and 438 in FIG. 14. Examples of means of incorporating shaped bristle like columns are provided later herein.

[0273] FIG. 16 shows a cut-away view of a friction pad 450 (e.g. of the tools of FIGS. 1 to 11)), which is also in the form of a lofty non-woven fibrous web and which may be appreciated to be a variant of that friction pad 430 of FIG. 14 and with similar height and fibre density. This friction pad 450 defines friction face 457 shown with larger reinforcement fibres 452, 452 of similar polymeric materials to those used in the web fibres or another frictional material chosen for its frictional properties when rubbed against the skin, which reinforcement fibres are inserted into the surface in the horizontal x 451 and y 452 planes to form part of the net-like layer of the friction face 454 on the friction pad 450. The introduced fibre x 451 and y 452 is flexible, resilient and may be elastic but cannot stretch much because they are constrained by adjacent inelastic fibres of the web 457. These reinforcement fibres 451 and 452 have substantially smooth under-surfaces 454 that act as frictional points of engagement with the surface of the skin and hair during sliding. The net-like form of the fibres at the first layer of the friction face define void spaces (net openings) 455 associated with void volumes 458. It will be appreciated that the fibres of a lofty non-woven web 450 are spaced apart and may be randomly orientated in any plane within the web but towards the face 457 are predominantly parallel with the friction face 457. The rectangle defined by 451, 452 of the net-like layer have been displaced and opened so their spacing is suitable for engaging hairs on the surface of skin and sliding without grabbing and stalling.

[0274] FIG. 17 shows a friction pad 460 (e.g. of the tools of FIGS. 1 to 11) which may be appreciated to combine elements of the friction pads 440, 450 shown in FIGS. 15 and 16 and thus, comprises both a net of added material 461, 462 with nodes 463; and a matrix of upright bristle columns 466; void volumes 467; and friction face 468. Thus, the web contains an inserted frame defined by intersecting crossing ties at the net-like friction surface 461, 462 and at each intersection of said cross ties a bristle like columns 466 is placed normal to the plane of the net-like face 468. In embodiments, there is provided a cellular reinforced matrix-like framework that stiffens (reinforces) the web 460 and provides more effective exercising of the hair and skin prior to wet shaving. The means of coupling the fibre web 460 to a planar support face on a rubbing tool must by sufficiently strong to withstand the additional mechanical loading encountered when rubbing with the reinforced pad 460, preferably by adding a backing that secures the vertical columns thereto.

[0275] It was found that the frictional surfaces on pads shown in FIGS. 14, 15, 16 and 17 were all effective for applying shaving lubricant and that the pad of FIG. 17 in particular, provided effective massage of the skin prior to wet shaving.

[0276] More generally, Applicant has observed that regular application of shaving lubricants with the friction tool herein extends razor blade cutting life. This is thought to be due to several favourable improvements. First, the tools when used according to the method the wetting of the hair is improved and this reduces hair strength that in turn reduces the cutting force and abrasion on the razor edge. Second by exercising skin and soft tissue supporting the skin, associated with a hair follicle and especially any training the arrector pili muscles over time, this causes the hair shafts to slightly stand off the skin and improves follicle support, thus the blade does not push the hair away as readily at the commencement of cutting, thereby providing a shorter cutting distance and less bending load at the cutting edge. Third, razor blade cutting edges are prone to wear and break-up that is attributed to fatigue cracks initiating at corrosion sites. It is believed that as static charges transfer too and from the vicinity of the cutting edge during shaving, metal ions are released causing micro pitting, at which sites electro-chemical corrosion often referred to as pitting corrosion is initiated. This charge transfer is said to be influenced by uneven charge distribution along a blade edge (see background in U.S. Pat. No. 5,329,699). Given that static or tribo-electric effects occur during frictional rubbing between surfaces, and in particular skin and/or hair and plastics and metals; therefore if unshaved hairs are rubbed with
preferably some conductive fibres and/or with water based lubricants carrying conductive agents, charge transfer is likely. Any transferred charges would presumably decay or cancel rapidly in the presence of water based shaving lubricants, therefore the better the wetting of the hair and skin with conductive agents the less retained charge and less likelihood of electrochemical corrosion and adhesion during cutting. Electro positive local charges are known to accumulate on areas of the epidermis, the dead outer layer of human skin that acts as an insulator when dry. It is believed the reduction of charge transfer reduces friction because it reduces hair adhesion onto the razor blades during shaving. In tests, after 400 consecutive shaves (mostly daily) with the same blade there was no evidence of pitting corrosion. In embodiments an antistatic agent should be incorporated in pre-shave chemical formulations for use with the rubbing tools herein. An example being a humectant like propylene glycol that should only be used in trace amounts because of known absorption dangers. Alternatively, in a further preferred embodiment, a proportion of the fibres of the net-like friction face on the friction pad are electrically conductive. Examples of the materials used in conductive fibres being polymers carrying conductive particles or nano particles of carbon dispersed on or in the fibre.

Finally the rheology of fluid materials applied by the friction tools described herein may change under the influence of stresses induced by the friction tools herein, such as shear forces, pressure, and temperature, which may affect the shaving resistance.

One method of manufacturing the friction pad shown in FIG. 14 or 15 (e.g. of the tools of FIGS. 1 to 11) is provided with reference to FIGS. 18a to 18c. FIGS. 18d to 18e show the pad 501 with portions 519 cut away to reveal the formed net-like first layer forming the pad rubbing face 507.

Referring to FIG. 18a, in the first step, an array of binder dispensing tubes (needles) 500 is aligned with a section of lofty non woven fibre pad 501, having depth 506. The pad 501 is also aligned with a section on a forming tool base 502 so that each dispensing tube is aligned with an intersection 503 between an array of shaping forms, shown as pyramids 504 (but alternatively may be cones—or some other suitable shape). It will be appreciated that in these simplified schematic diagrams only small sections of the tool 502 and pad 501 are shown. In practice the forming tool may take the form of larger blocks or rolls mounted in substantial machine frames, with means for operating and controlling the following automated steps.

In a second step in FIG. 18b the pad 501 is pressed against the forming tool 502, 504 and the pyramids 504 penetrate the under surface 505 and forms the net-like under face 507 by displacing and indenting the randomly oriented fibres 506 of the pad 501. Those fibres near the face of the pad 505 are displaced sideways by the side faces of the pyramids 504 as they penetrate into the web; this bunches fibres together into gaps between pyramids 503 to form a net like pattern 507 on the friction face.

FIG. 18a also shows the third step in which the dispensing tubes 500 are pressed into the deform non-woven fibre pad 501 and penetrate to position 509 above the bunched intersecting fibres at 511 at 503 on forming tool. FIG. 18d further shows the fourth step where a metered amount of binder is dispensed from each inserted dispensing tube 500 at 509 to form a blob 510 that binds together bunched intersecting fibres 508, 511.

FIG. 18c shows the fifth step in which the dispensing tubes 500 are withdrawn to 512 leaving a blob of binder 510 at each corner of the net like form 507. FIG. 18e also shows how the fibres within the body of the non woven web 501 are displaced inwards 506 by the forming tool pyramids 504 to create void volumes 513 similar to the friction pad 438 of FIG. 14.

The final sixth step being the curing of the binder which depends on the binder material—for example it can either be done by applying heat from the forming tool or UV after the pad is removed from the tool. The completed pad shown in FIG. 18e resembles that shown in FIG. 14.

Referring to FIG. 18d and by changing the fifth step in the above sequence, binder or an alternative material for forming bristle like columns 521 is dispensed as the dispensing tubes 500 are withdrawn from fully inserted position 522 up to 520 leaving a bristle like bead of curable material 521 extending upwards from the binding blob 510 to the top surface of pad 501. After curing in a final sixth step and removal from the tool the finally formed pad is shown in FIG. 18e, which is similar in construction to that pad shown in FIG. 15.

Although not shown it will be appreciated that the bristle like columns 521 might be formed from materials dispensed from a second set of dispensing tubes (not shown) aligned and inserted after the first tubes are withdrawn. The bristles 521 may then be formed with a different material to the binder blobs 510. It will be further appreciated that for some uses it is beneficial to couple the individual bristles to a base that in turn can be more readily attached to a tool holder as shown earlier herein (FIGS. 1 to 11).

The binder material used in the manufacture of the examples of friction pads shown in FIGS. 18, 19, 20, 21, 22, 23 are applied in fluid form and need to solidify, for example by cross linking or curing usually by application of external energy once the liquid has penetrated to the desired depth. The external energy applied as heat to evaporate solvents or ultra violet light (UV) to initiate chemical interactions. By way of a guide, the bristle material may be either a single or two pack system where the second pack includes a catalyst. Some suitable materials may be selected from the Cemadine Japanese range, for example the Ceramide silicone modified polyester type ER001. An alternative material supplied be Delo Industrial Adhesives AG D-86949, designated Delo-Photobond 4442, a registered mark, described in their literature as a modified acrylate that is solvent free and said to have been tested for its biocompatibility and fulfills the requirements according to USP 23, 1995, for Class VI Plastics—70° C. Alternatively the forming base 502, 504 may be heated sufficiently to dispense hot melt adhesive (an alternative forming tool with dispensing means is shown in FIGS. 20a to 23c). A material that potentially might be used for this purpose with nylon fibre is Wacker Geniomer 140, (Geniomer being a registered mark of Wacker-Chemi AG—D-81737), described as a thermoplastic silicone elastomer that extrudes at about 160° C. The fibre must withstand these temperatures while beneficially softening to facilitate thermoforming into the net-like form.

One method of manufacturing further variants of the friction pads shown in FIGS. 16, 17 (e.g. of the tools of FIGS. 1 to 11) is provided with reference to FIGS. 19a to 19e. FIGS. 19b to 19e show the non-woven web 501 with portions 519 cut away to reveal the formed net-like first layer forming the pad rubbing face 507.
Referring to FIG. 19a, in the first step a section of an array of needle like dispensing tubes 500 are aligned with a section of non woven fibre pad 501 with depth 506 that is aligned with a section of a preformed net 530 that is aligned with an array of pyramids 504 on forming tool base 502. It will be appreciated that these simplified schematic diagrams only small sections of the forming tool and webs are shown. In practice the forming tool may take the form of larger blocks or rolls mounted in machine frames together with means for operating and controlling said machines which are not shown.

In a second step shown in FIG. 19b the pre-form net 530 is placed in the gaps 503 between the pyramids.

In a third step the lofty non woven pad is pressed against the forming tool and over net 530 and the pad is deformed by the pyramids 504 penetrating into the pad causing the fibres to be displaced sideways into a net like surface 507 running between the pyramids 504 and with net 530.

In a fourth step shown in FIG. 19c the dispensing tubes 500 are inserted into the deformed non-woven fibre pad and penetrate to position 509 above bunched fibres 511 located at each corner of each pyramid 504.

FIG. 19b shows the fifth step where a metered amount of binder is dispensed from each inserted dispensing tube 500 at 509 to bind together intersecting fibres 511 and added net fibres 531, 532.

FIG. 19c shows the sixth step in which the dispensing tubes 500 are withdrawn to 533 leaving a blob of binder 534 in the bound intersections 535 of the net-like layer.

The final seventh step being the curing of the binder which depending on the binder material—for example it can either be done by applying heat from the forming tool or UV after the pad is removed. This construction is similar to that shown in FIG. 16 with reinforcement fibres 531, 532 bunched with the fibres of the web at the friction face 507.

FIG. 19d shows a further variant of the friction pad in which vertical columns are added to the pad shown in FIG. 19c. In an alternative procedure step six is changed, in new step 680 the binder or an alternative material is dispersed from tube 500 they are withdrawn from tip position 509 to 535. This produces a bristle like beads of material 536 extending upwards from the binding bob 509 to the top surface 537 of pad 501.

After curing in a final alternative seventh step and removal from the tool, the formed pad is shown in FIG. 19e, which is similar to construction shown in FIG. 17 that combines a net 531, 532 with bristles 536 with fibres at the friction point.

Although not shown it will be appreciated that the bristle like columns 536 might be formed from materials dispensed from a second set of dispenser tubes separately inserted after the first tubes are withdrawn and 536 can thereby be formed with a different material to the surface binding blobs 534. Although not shown it will be appreciated that a backing plate can be attached to the pad 501 in FIG. 19e and the ends of the vertical columns 537 can be bonded to said backing plate to form a brush like structure set within the web. In embodiments there is provided a friction pad with a brush like structure with bristles embedded into a lofty non woven web, wherein the friction pad further comprises a net-like layer provided at said friction face.

One alternative sequence of steps for manufacturing the friction pad of FIG. 14 (e.g. of the tools of FIGS. 1 to 11) is shown at FIGS. 20a to 20d, in which the binder is dispensed onto the net like friction face via holes 680 in the base of the forming tool 670.

As a first step it may be seen that a section of lofty non-woven fibre pad 501 of depth 631 is aligned above a section of a shaping tool 670. The pad 501 is the same as used in previous examples and comprises a generally random arrangement of fibres therein. The shaping surface of the shaping tool 670 may be seen to be formed with a matrix of pyramidal form shaping projections 672 arranged such that a net-like surface layer 674 defining net nodes 675 thereat is defined between the projections 672. At FIG. 20b the fibre pad 501 is shown with a section cut away 632 to reveal how shaping tool 670 interacts with pad surface 676.

As a second step, the pad 501 has been brought into contact with the shaping surface 672, 674, 675 of the shaping tool 670 and pressed and held against it. The effect of this contacting is to displace and order the previously random arrangement of fibres of the pad 501 into an ordered, net-like surface layer 636 as shown at FIG. 20c comprising a matrix of net loops 633 bunched at either and at node points 635. Void spaces 634 are defined at the friction face 636 underneath. Behind each net opening 634 each pyramidal shape of forming tool 672 disperses fibres 676 upwards and sideways to create a void volume as shown at 681 in FIG. 20d.

In a third step shown in FIG. 20b a metered amount of fluid binder is applied at each fibre crossing node 635 via orifices 680 in the base 670. The location and direction of binder injection is shown by the array of arrows 677. The binder binds the fibres at the intersections on the net like layer 636 by forming binding blobs of curable binder 679.

In a fourth step the finished pad is shown removed from the forming tool 670 in FIG. 20d, which shows the formed pad 501 with cutaways 632 to reveal blobs of binder 679 uniformly distributed across the uniformly formed net like friction face 636. Void volumes 681 are shown behind void spaces 634. The binder then needs to be cured by an appropriate method depending upon the binder. The Binder being preferably cured against a flat inert surface like Teflon to ensure the undersides of the blobs is smooth.

It will be appreciated that during the forming the spacing of the fibres in the webs will decrease as the net like form is impressed, the spacing of the formed fibre chosen to hold for example pre-shave impregnates carrying enough water to facilitate a shave without the need to apply additional water.

FIGS. 21a to 21c shows an alternative sequence of steps for manufacturing a variant of the friction pad shown at FIG. 16 (e.g. of the tools of FIGS. 1 to 11) in which a reinforcement/strengthening net is added to the rubbing face thereof. The section of formed friction pad of FIG. 21c is identical to that of FIG. 20d save for the addition of a separate net-form 700 incorporated in the friction face to strengthen it. In FIG. 21a a net form 700, which differs from that shown earlier at 530 in FIG. 19b by being of smaller diameter and consists of separate fibres 701 and 702 laid one over the other. Only the additional manufacturing steps of incorporating this net are now described, which is intended to have the general manufactured form of the friction pad first shown in FIG. 16.

In a first step FIG. 21a shows a section of lofty non woven web 501 (identical to those shown in FIGS. 18a, 19a and 20a) is positioned above and aligned with net form 700.
comprising separate lateral members 701, 702 that in turn are positioned above and aligned with a section of a forming tool 670.  

[0306] In the second step fibres 701, 702 are shown laid in grooves 703, 704 running between the pyramids 672 on forming tool 670. Single or (although not shown) multiple strands of suitable fibres may be laid in said grooves 703, 704.  

[0307] In the third step, fibre pad 501 is pressed against the forming tool 670.  

[0308] In a fourth step binder 677 is dispensed via holes 680 in the tool base.  

[0309] In a fifth step the binder is cured and the pad removed identical to those steps described earlier with reference to FIGS. 20a to 20d.  

[0310] FIGS. 22a to 22c: show an alternative sequence of steps for manufacturing a variant of the friction pad shown at FIG. 15 (e.g. of the tools of FIGS. 1 to 11). This variant differs by employing hollow bristle 801 like columns in place of the extruded solid bristle like columns of FIG. 15.  

[0311] In a first manufacturing step a section 800 of thermo formable or injection moulded polymeric sheet (outline shown dotted at 800) carries hollow pre-formed conical bristle protrusions 801 that are aligned above a matching section of non-woven web 501, which in turn is aligned with the forming tool 670 so the bristles 801 are aligned with the intersection of the valleys 674 at 675 between the forming pyramids 672 and binder injection holes 680.  

[0312] In a second step the pre-formed sheet 800 is coated with adhesive on its underside 802 and pressed against lofty non-woven web 501, the tapered bristle like projections 801 are long enough to fully penetrate the web 501 to full depth 631 upon insertion.  

[0313] In a third step in FIG. 22b the web 501 with backing 800 attached is pressed against the tool 670 as described earlier with reference to FIGS. 20b to 20d. It will be appreciated that the insertion of bristles can alternatively be done after pressing the web onto the forming tool.  

[0314] In a fourth step binder 677 is injected via orifices 680 in base in a sufficient amount to form bead 803 that covers and binds the tip of cone 801 at 804 and to the fibres 805 of net like arrangement at the friction face 806.  

[0315] In a fifth step the pad is removed from tool and binder is cured as described hereinbefore with reference to FIGS. 20a to 20d. It will be appreciated that the actual shape and size and material stiffness of the bristles 801 is chosen to suit the application. The bristle materials may differ from that used as a binder and is again chosen to suit the application.  

[0316] FIG. 22c shows the finished friction pad with net like friction face 806 with blobs of binder 803 securing the tips of conical hollow bristle like columns 801, the columns attached to a backing sheet 800.  

[0317] FIGS. 23a to 23c: show an alternative sequence of steps for manufacturing a variant of the friction pad as shown of FIG. 17 (e.g. of the tools of FIGS. 1 to 11). The section of friction pad of FIG. 23c: is identical to that shown at FIG. 22c: save for the addition of stiffening net incorporated within the fibres of the net like friction face. Most of the manufacturing steps for this variant have therefore already been described and are summarised as follows with reference to the earlier diagrams.  

[0318] In a first step, a section of formed plastic sheet 800 with hollow bristle like protrusions 801 thereon is aligned over a matching section of non-woven web 501 that in turn is positioned and aligned over a matching section of strengthening diagonally arranged fibres 701, 702 forming a strengthening net 700. These fibres aligned with the valleys 674, 675 between the pyramids 672 so their crossings are above the dispensing tubes 680 in forming tool base 670.  

[0319] In a second step the pre-formed sheet 800 is coated with adhesive on its underside 802 and pressed against lofty non-woven web 501, the tapered bristle like projections 801 being pressed into the web 501 to the full depth of the web 631.  

[0320] In a third step, reinforcement fibres are arranged in tool groves 674  

[0321] In a forth step and with reference to FIG. 23b web 501 with bristle sheet 800 attached is pressed against forming tool 670 as described hereinbefore with reference to FIG. 20a.  

[0322] In a fifth step binder 677 is injected via dispensing holes 680 in base 670 to bind bristles 801 to net form 703, 704 with blobs of binder 803 and formed net like fibre array 637, the binder applied at each intersection 635.  

[0323] In a sixth step the assembled pad is removed from forming tool and binder is fully cured. The finished friction pad is shown in partial cross section 632 at FIG. 23e: where the fibre pad 501 is cut away to show formed fibres in net like layer forming friction face 807 with reinforcement fibres 703, 704 and hollow conical bristle like columns 801 bonded at their tips by blob 803 thereto.  

What is claimed is:  

1. A friction tool for use in a cosmetic method for the treatment of mammalian skin, the tool comprising a body;  

   said body defining a support having a planar support face;  

   a resiliently deformable friction pad provided to said support face, said friction pad defining a friction face, wherein the friction pad further comprises a net-like layer provided at said friction face.  

2. A friction tool according to claim 1, wherein the friction pad comprises a lofty non-woven fibre material and the net-like layer is provided as a separate layer to the lofty non-woven fibre material.  

3. A friction tool according to claim 1, wherein the friction pad comprises a lofty non-woven fibre material and the net-like layer is provided as an integral layer to the lofty non-woven fibre material.  

4. A friction tool according to claim 3, wherein the net-like layer is provided by adapting the lofty non-woven fibre material such as to define a net-like layer integral therewith.  

5-10. (canceled)  

11. A friction tool according to claim 1, wherein the friction pad comprises a lofty non-woven fibre material comprising a web of interlaced non-woven fibres in the form of a three dimensional fibrous matrix with said non-woven fibres orientated and spaced to thereby define the net-like layer.  

12-52. (canceled)  

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