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(54) **HANDHELD MECHANICAL SOFT-SURFACE REMEDIATION (SSR) DEVICE AND METHOD OF USING SAME**

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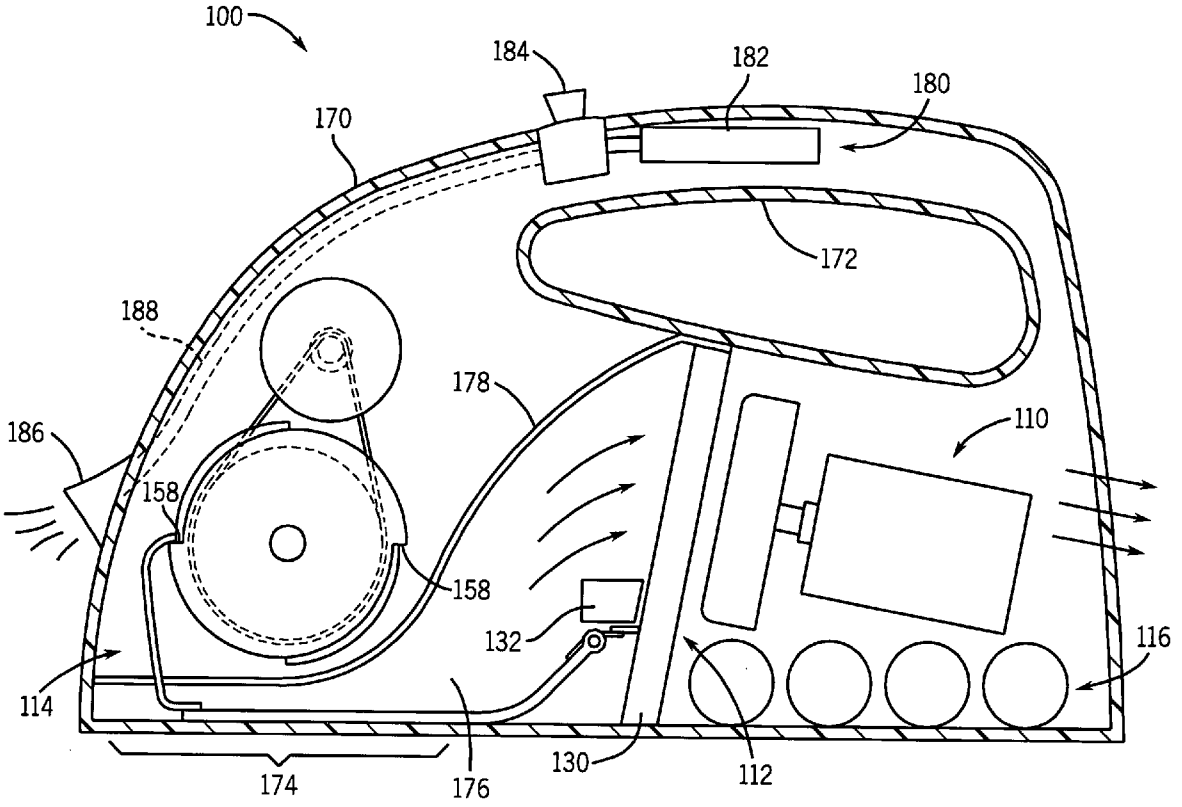
(57) **ABSTRACT**

A handheld mechanical soft-surface remediation (SSR) device and method of dislodging, displacing, and disposing of particulates from surfaces and performing disinfection and/or freshening is disclosed. The device is preferably lightweight, easy-to-use and includes a fan assembly, filter assembly, flapper assembly, battery assembly, and chemical delivery system. Performing soft-surface remediation with the mechanical SSR device includes the steps of retrieving the device from storage, installing the consumables into the device, activating the device, performing the cleaning operation, deactivating the device, removing the consumables from device, preparing the device for the next use, storing the device and, optionally, recharging the batteries.



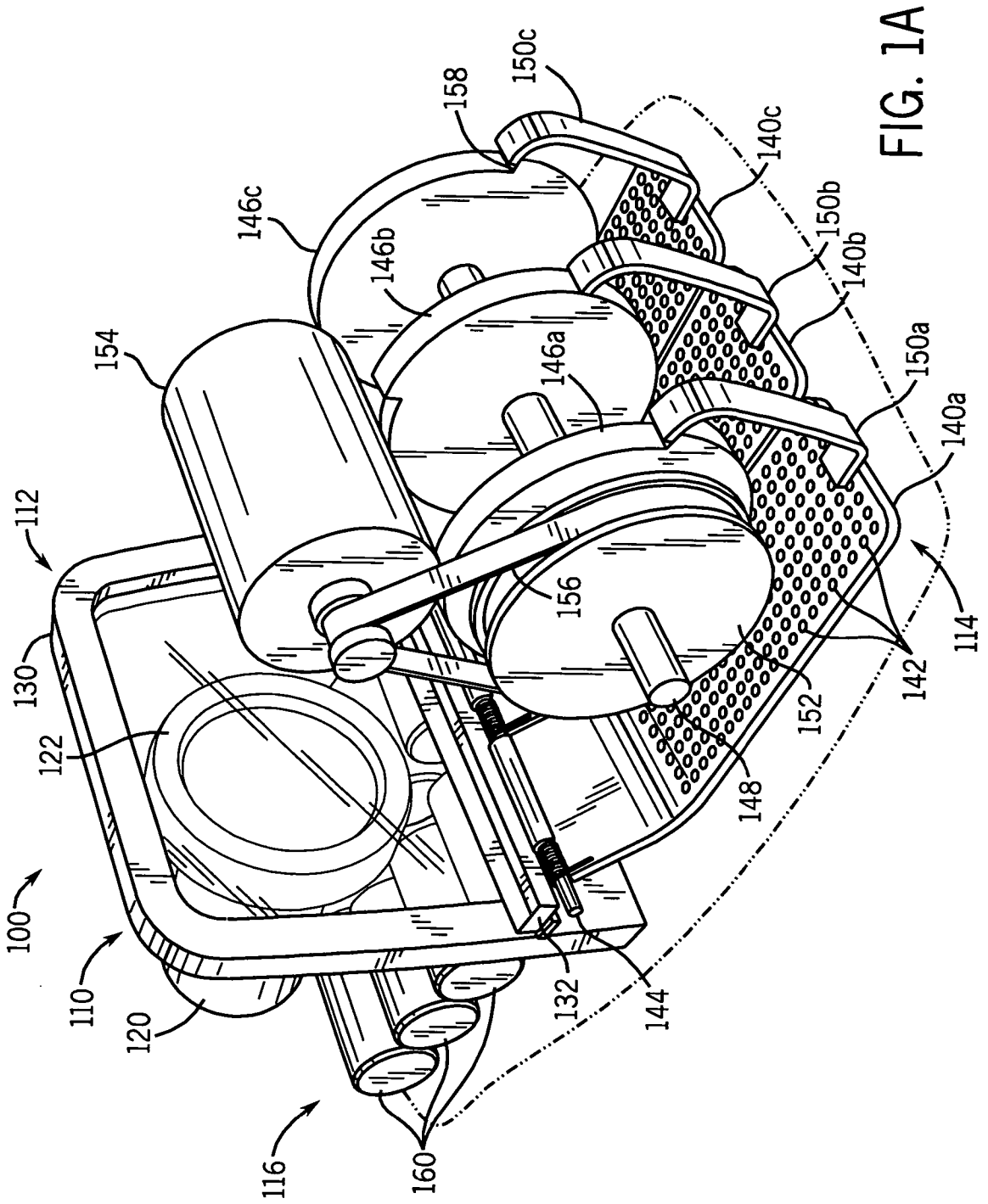

100
110
112
114
116
120
122
130
132
140a
140b
140c
142
144
146a
146b
146c
148
150a
150b
150c
152
154
156
158
160

FIG. 1A

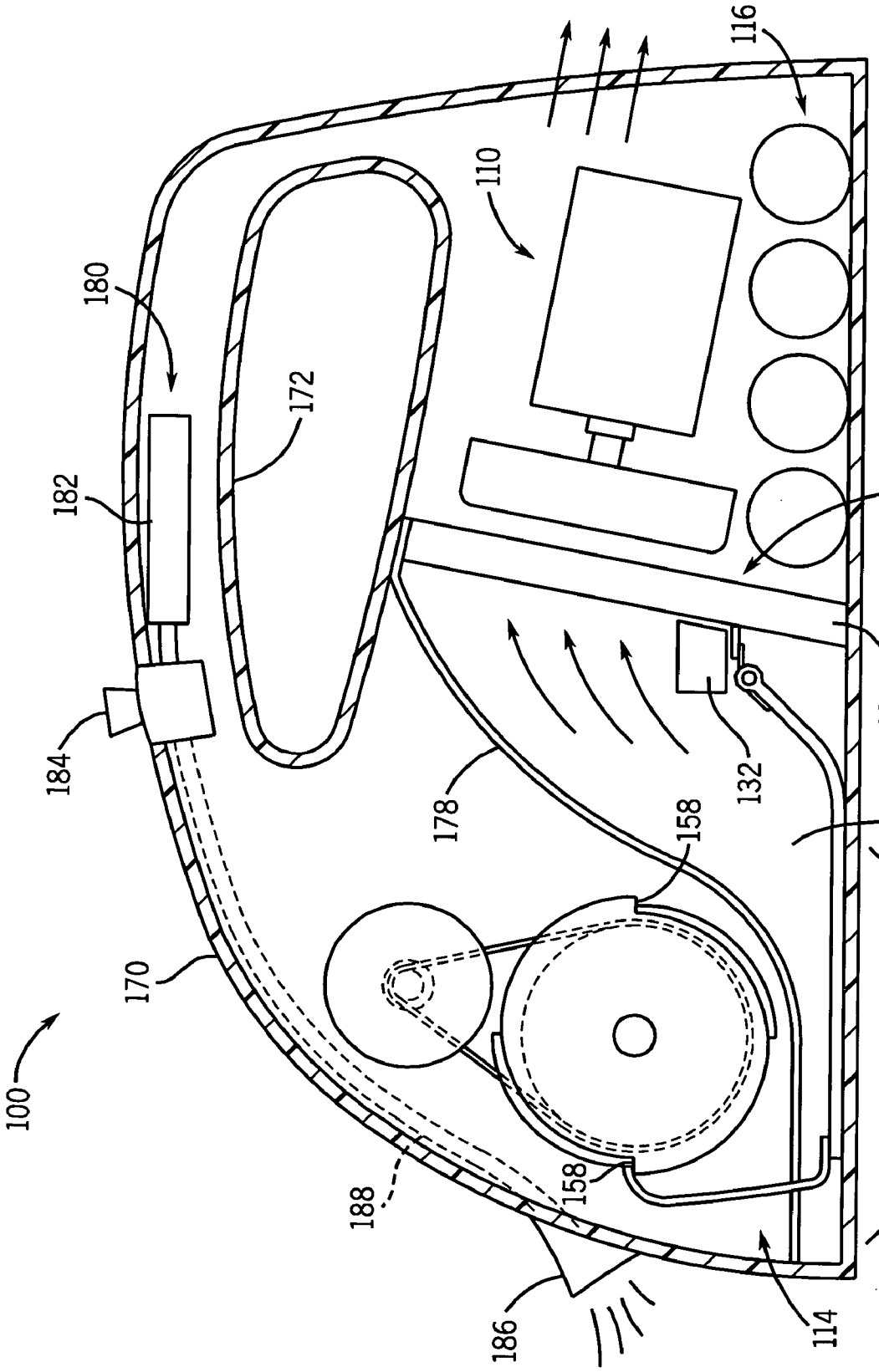

116
110
180
172
182
112
130
184
132
178
158
176
170
174
100
188
158
186
114

FIG. 1B

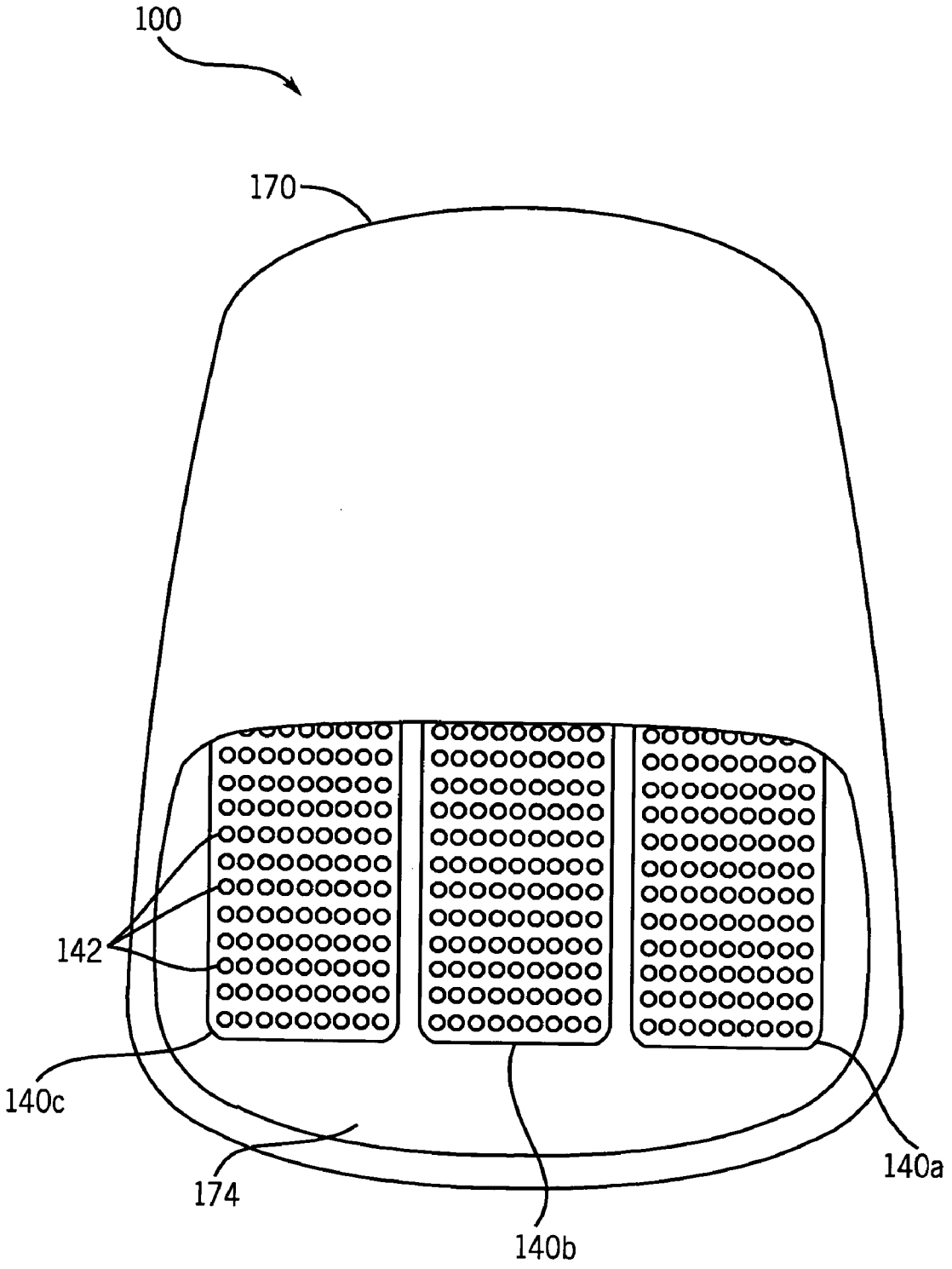


FIG. 1C

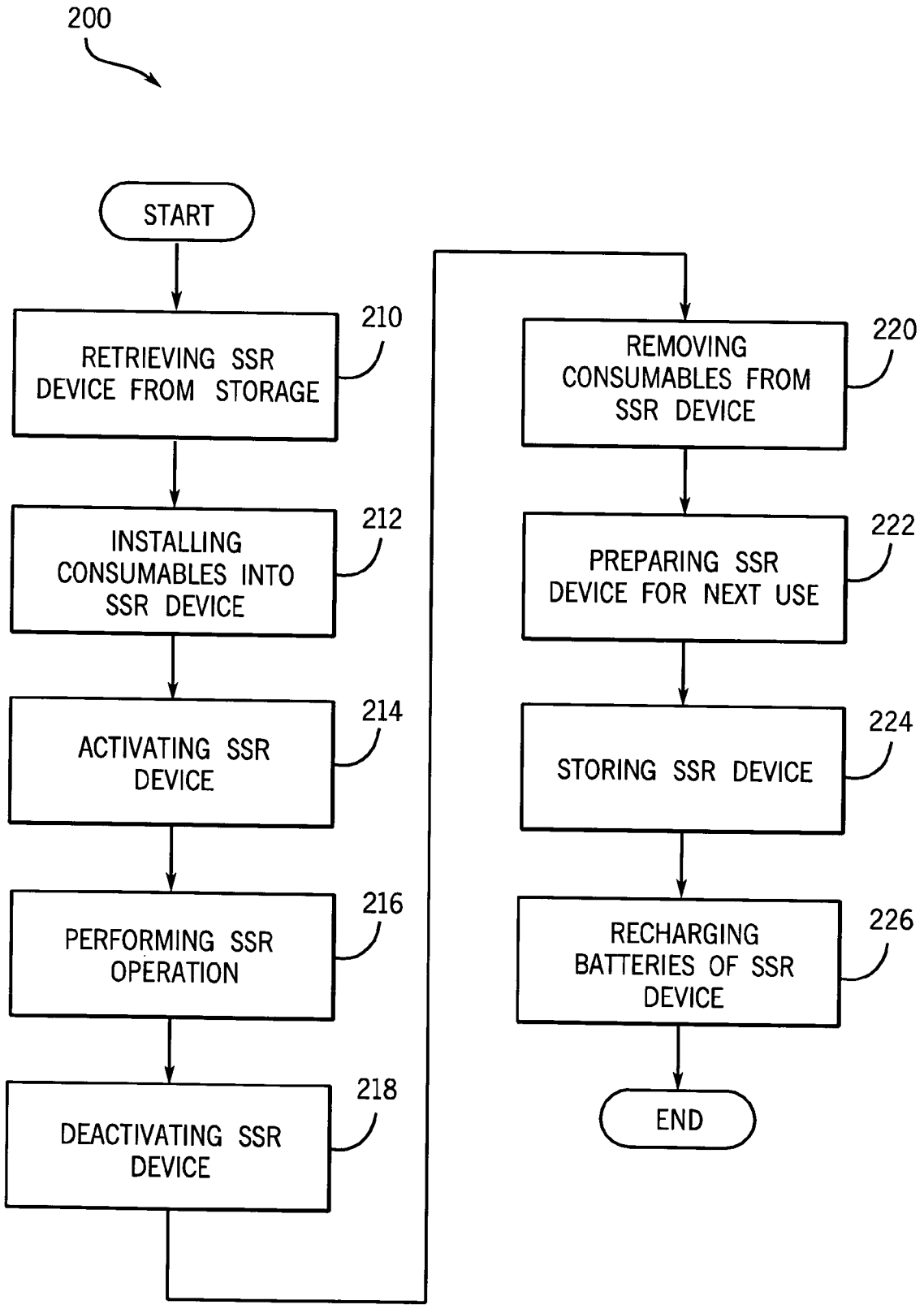

200
START
RETRIEVING SSR DEVICE FROM STORAGE
210
INSTALLING CONSUMABLES INTO SSR DEVICE
212
ACTIVATING SSR DEVICE
214
PERFORMING SSR OPERATION
216
DEACTIVATING SSR DEVICE
218
REMOVING CONSUMABLES FROM SSR DEVICE
220
PREPARING SSR DEVICE FOR NEXT USE
222
STORING SSR DEVICE
224
RECHARGING BATTERIES OF SSR DEVICE
226
END

FIG. 2

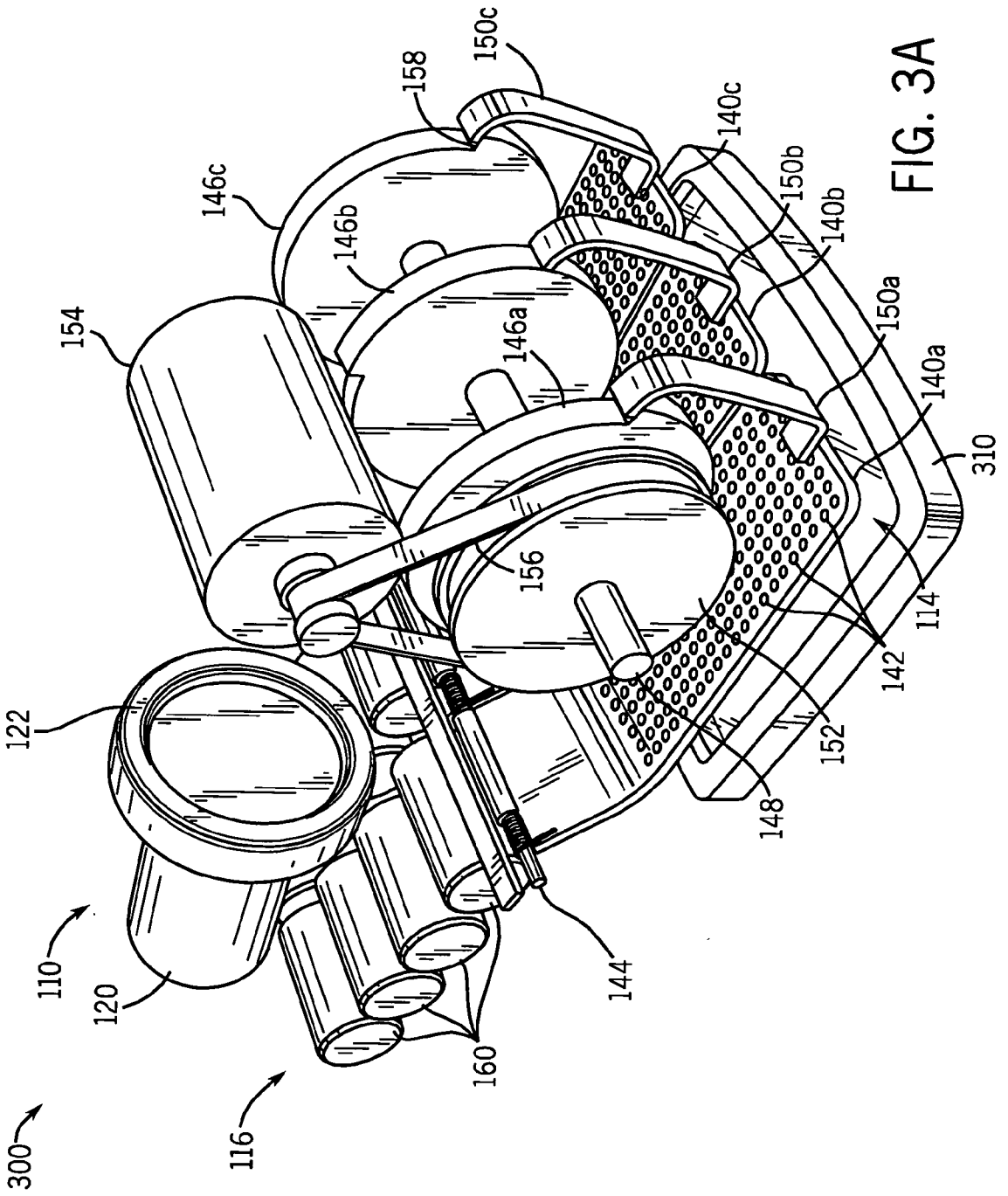

300
116
110
120
122
154
146c
146b
158
150c
140c
150b
140b
146a
150a
140a
310
156
114
142
152
148
144
160

FIG. 3A

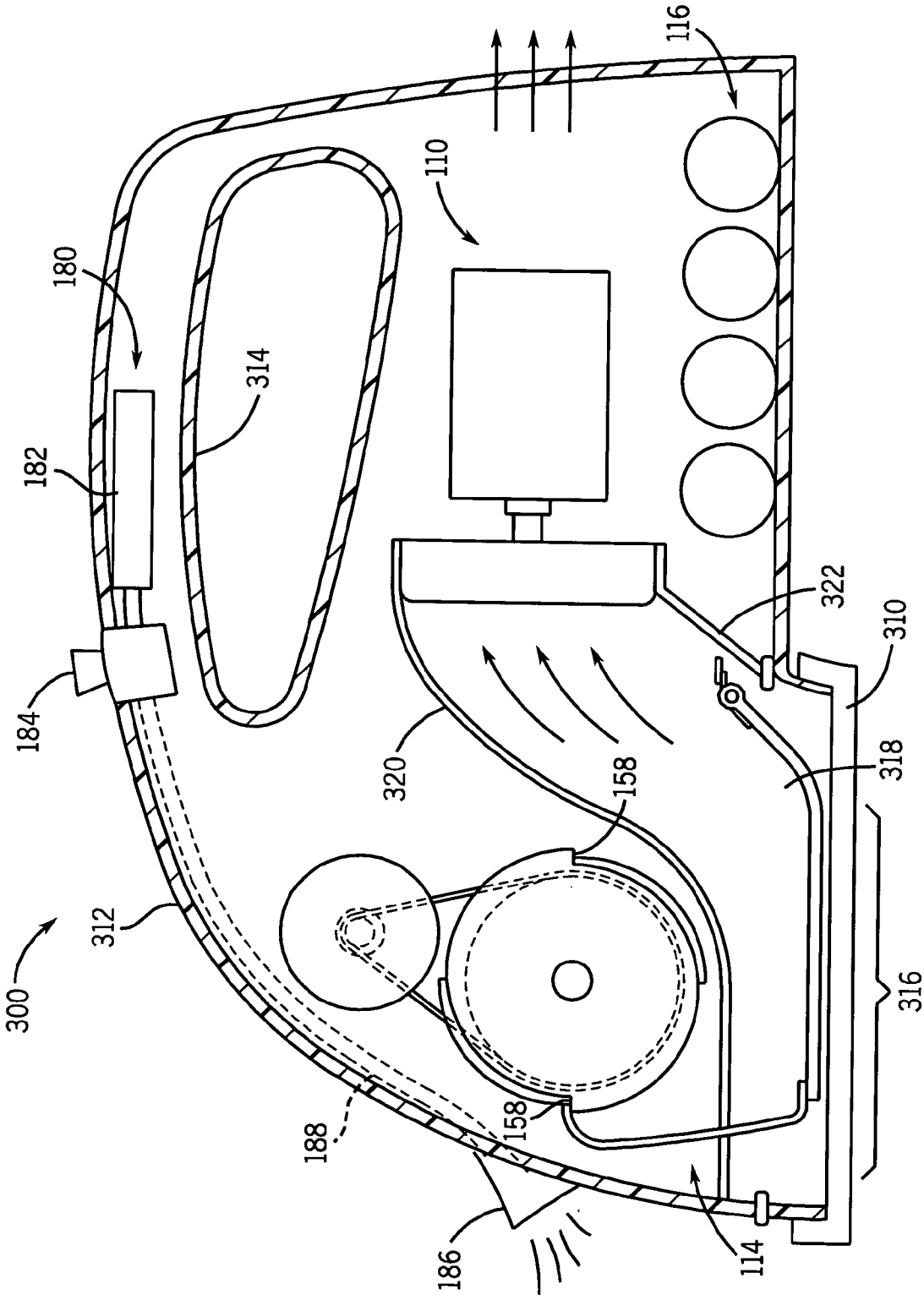

116
110
180
314
182
184
322
310
320
158
318
312
316
300
188
158
186
114

FIG. 3B

HANDHELD MECHANICAL SOFT-SURFACE REMEDIATION (SSR) DEVICE AND METHOD OF USING SAME

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an apparatus for soft-surface remediation (SSR). In particular, this invention relates to a handheld mechanical SSR device for dislodging, displacing, and disposing of particulates from soft-surfaces and for performing disinfection and/or freshening.

[0003] 2. Discussion of the Related Art

[0004] Indoor air is a very good transport mechanism for airborne particles or contaminants, such as dust and allergens. Dust is generally characterized as including, for example, soot, pet dander, skin flakes, carpet fibers, dust mite feces, hair, and lint. Allergens are generally characterized as including, for example, dust mites, pet dander, mold/mildew, pollen, and germs/bacteria. For energy efficiency reasons, modern homes are constructed to be as air-tight as possible, which has the adverse effect of creating an environment of poor indoor air quality, because it takes a significant amount of time to circulate air into and out of a room. Consequently, airborne contaminants remain circulating in the air and, over time, may land on hard and soft surfaces in the home. Hard surfaces are, for example, floors, counter tops, and the wooden, metal, or glass components of furniture. By contrast, soft surfaces are, for example, upholstery, carpets, mattresses, and drapes.

[0005] Soft surfaces are typically formed by a number of strands of thread or fiber that are woven together in a specific pattern to form a thick surface. Alternatively, the fiber may be in the form of a thin, non-woven mesh. However, most furniture upholstery is of the woven type. Airborne particles become lodged in between the weave of the fibers and onto the fibers themselves. A common structure of upholstered furniture is outer woven fabric atop a thin layer of batting material, which is atop a thick inner foam that provides firmness for, for example, supporting a person's weight. The vast majority of contaminants reside within the weave of the surface fabric or on the batting material of the upholstered item. The surface of the outer woven fabric becomes a collection area for crumbs, hair, dust, lint, and stains. In particular, hair, dust, lint, and dust mite feces become lodged between the surface fabric weave. The batting material becomes a repository for hair, dust mites, dust mite feces, and mold/mildew spores. Finally, mold/mildew spores, bacteria, and germs are commonly found on the surface of the inner foam.

[0006] Technical challenges exist with regard to SSR, which as used herein is any treatment to relieve, prevent, or cure the adverse effects of contaminants that collect thereon. There are generally four components of soft-surface remediation that may be defined as follows: (1) dislodging, which is the act of freeing dust, dirt, hair, etc., from or near the surface, (2) displacing, which is the act of moving dust, dirt, hair, etc., to a containment mechanism after it has been dislodged, (3) disposing, which is the act of capturing the contaminants via a containment mechanism, and (4) disinfecting/freshening, which is the act of applying a treatment to control dust mites, bacteria, mold, etc. or, alternatively, to remove odors or otherwise improve the scent or perceived "freshness" of the soft surface.

[0007] A vacuum cleaner is a well-known household item used for cleaning. A typical vacuum cleaner consists of a suction fan driven by a motor and a suction nozzle with a rotating brush that has a beating effect (for dislodging) on the surface to be cleaned, such as a carpet. Vacuum cleaners exist in various forms, such as a canister type or upright type of design. Both types of vacuum cleaners have considerable weight and are, therefore, cumbersome to use. Additionally, typical canister or upright vacuum cleaners are corded, which limits their easy accessibility to some areas of the home. In particular, standard vacuum cleaners are too cumbersome for use on soft surfaces, such as furniture upholstery, mattresses, and drapes. Furthermore, the mechanical dislodging mechanism of standard vacuum cleaners are destructive the fabric itself.

[0008] Alternatively, handheld portable vacuum cleaners exist in the market today, such as the DustBuster® handheld vacuum manufactured by Black & Decker (Towson, Md.). However, handheld portable vacuum cleaners do not include a dislodging mechanism; they use vacuum power only. Consequently, handheld portable vacuum cleaners are not powerful enough to clean to any sufficient depth and, thus, only the surface is cleaned. In particular, handheld portable vacuum cleaners are not effective in removing hair, as hair is difficult to remove, because of the static cling to fabrics and the entanglement into the weave of the fabric itself. What is needed is a handheld SSR device that has a dislodging mechanism for effectively performing soft-surface remediation, but in a non-destructive manner. Additionally, handheld portable vacuum cleaners have a small opening, so the user must operate the device slowly over the surface to be cleaned, in order for it to work effectively. Furthermore, what is needed is a handheld mechanical apparatus that has a large pickup area, in order to reduce the cleaning time.

[0009] A chemical, e.g., a cleaner, or another ingredient is sometimes desired for freshening, disinfection, or for assisting in the removal of contaminants from a soft surface. It is difficult to introduce chemistry to the surface to be cleaned by use of a standard vacuum cleaner or a handheld portable vacuum cleaner, as neither includes a chemical delivery system. The consumer must, therefore, resort to a separate device for applying a chemical or fluid, which means that the consumer is spending additional time performing separate cleaning, freshening, and disinfecting operations. What is needed is a more effective and efficient way to introduce a fluid or other material onto a soft surface by use of a low-powered, light-weight, handheld mechanical apparatus and, therefore, reduce the overall time for performing cleaning, freshening, and disinfecting operations.

[0010] As a preventative measure, frequent touchup cleaning is beneficial to soft surfaces for delaying more involved and destructive deep-cleaning events. Generally, upholstery does not get as dirty when frequent touchups are performed, as compared with relying on occasional deep cleaning. However, consumers tend not to do touchup cleaning, because existing soft-surface touchup cleaning approaches are not very effective. Deep cleaning is effective, but very laborious and requires powerful tools, chemistry, and energy. Furthermore, the more effective the deep-cleaning

event, the more damaging it is to the soft surface. What is needed is an easy-to-use, convenient mechanism for performing touchup cleaning that encourages frequent use and, thus, minimizes the need for deep-cleaning events.

[0011] The disclosures of all of the below-referenced prior United States patents, and applications, in their entireties are hereby expressly incorporated by reference into the present application for purposes including, but not limited to, indicating the background of the present invention and illustrating the state of the art.

[0012] U.S. Patent Application No. 20040172769, "Method and apparatus for cleaning fabrics, floor coverings, and bare floor surfaces utilizing a soil transfer cleaning medium," invented by Daniel G. Giddings (Holland, Mich.), Frederick A. Hekman (Holland, Mich.), Richard W. Wellens (Plymouth, Minn.), and Larry D. Wydra (Plymouth, Minn.), describes an apparatus and method for cleaning fabrics, floor coverings, and bare floor surfaces utilizing a soil transfer cleaning medium. A method of mechanically removing soil from a surface intended to be cleaned includes the steps of successively and repeatedly: wetting a portion of a cleaning medium with a cleaning liquid; extracting any soil and at least some of the cleaning liquid from the previously wetted portion of the cleaning medium; and wiping the surface intended to be cleaned with the portion of the cleaning medium so as to transfer soil from the surface intended to be cleaned to the cleaning medium. Portable and vehicle-based devices may be utilized to practice the method of cleaning.

[0013] U.S. Patent Application No. 20020104184, "Portable vacuum cleaning apparatus," invented by Alma L. Rogers (Stockridge, Ga.) and Dietrich Hoecht (Loganville, Ga.), describes a portable vacuum cleaning apparatus intended to be carried either on a single shoulder or worn backpack style, wherein the vacuum cleaner has an extensible tube and nozzle arrangement that may be held substantially fully enclosed in the vacuum cleaner case, wherein the hose or wand may be collapsed when not in use to prevent entanglement, or may be incrementally extended and secured in a desired position for use. Additional advantages of the present invention include a suspension arrangement for flexibly suspending the internal components of the vacuum and for providing a moment to counteract the force and movement of the wand.

[0014] U.S. Pat. No. 6,746,166, "Apparatus for cleaning a surface," assigned to Art Center College of Design (Pasadena, Calif.), describes an apparatus for efficiently cleaning stains and extracting cleaning fluid from surfaces such as carpets and upholstery without requiring electrical power is presented. The invention eliminates the inconvenience of retrieving, filling with cleaning fluid, and plugging a deep cleaner into an electrical outlet in order to remove a small spot from a carpet. In addition to the scrubbing and fluid extracting capabilities, embodiments of the invention include a sprayer for applying cleaning fluid to stains. The sprayer may receive fluid from an attached refillable reservoir of cleaning solution, for example. During scrubbing, the top of a pump actuator provides a resting place for the heel of a user's palm. The pump actuator may be locked down when scrubbing and unlocked for pumping to suck up fluid. A piston in a chamber provides the suction force for pulling fluid up through tubules, which may be interspersed between bristle tufts, past check valves and into a waste reservoir. A downward force on the piston provides the suction thereby assuring that the tubules are in contact with the surface during suction. The waste reservoir may be dumped via a plug in the waste reservoir.

[0015] U.S. Pat. No. 5,604,953, "Vacuum cleaner," assigned to Aktiebolaget Electrolux (Stockholm, SE), describes vacuum cleaner including a unit, comprising an electric motor and an associated suction fan, and a suction nozzle (36) connected to the inlet side of the unit via a dust separating device (15), either directly or via a connectable rigid conduit (13). The vacuum cleaner comprises a handheld unit (10) which when not in use is arranged to be positioned on a stationary storage unit (11), said handheld unit (10) incorporating the said unit and the dust separating device (15) and being provided with a coupling means (12) for connecting of the rigid conduit (13). For power supply purposes, by means of an extensible flex (26), the handheld unit (10) is connected to the storage unit (11) which via an additional flex (39) is connectable to a mains outlet.

[0016] U.S. Pat. No. 5,551,122, "Corded handheld vacuum cleaner," assigned to Electrolux Corporation (Atlanta, Ga.), describes a handheld vacuum cleaner that has a motor mounted with the rotational axis of its shaft parallel to the rotational axis of the rotating brush. The vacuum cleaner motor has an end bell, which is attached to the motor stator, and which holds a motor shaft bearing. The end bell is secured to the vacuum housing with an elastomeric mounting ring to dampen motor vibrations. The need for most motor mounting hardware is eliminated, because the housing supports the motor stator directly. The intake orifice of the vacuum is shaped to lie in two distinct planes, so that flat cleaning surfaces do not obstruct the orifice. The shape of the intake also allows one to clean immediately adjacent to a vertical wall.

[0017] World Intellectual Property Organization Application No. WO8301734, "Dust remover for removing dust, hair, or other loose particles from objects such as clothes, textiles, furniture, etc.," describes a dust remover for removing dust, hair or other loose particles from the surface of objects such as clothes, textiles, furniture etc comprising a substantially cylindrical roller (1) which is rotatably supported on a holder, the peripheral surface of said roller being provided with an adhesive layer (6) for removing said dust particles etc by adhesion when the roller (1) is brought into rolling contact with the surface of the object to be cleaned. The dust remover comprises a divided casing, the casing parts (7, 11) being movable in relation to each other by relative rotational movement between a position in which the casing parts (7, 11) completely enclose the roller (1), and a position in which the roller (1) is partly exposed for enabling rolling contact with the object to be cleaned. The casing parts (7, 11) are arranged for relative rotational movement about an axis that is parallel to, and preferably coaxial with the rotational axis of the roller (1).

[0018] Also incorporated by reference herein is the disclosure contained in U.S. application Ser. No. 11/090,438 entitled "SOFT-SURFACE REMEDIATION DEVICE AND METHOD OF USING SAME" and assigned to S.C. Johnson & Sons, Inc.

SUMMARY OF THE INVENTION

[0019] It is therefore an aspect of the invention to provide a handheld SSR device that has a dislodging mechanism for effectively performing soft-surface remediation in a non-destructive manner.

[0020] It is another aspect of this invention to provide a low-powered, light-weight, handheld mechanical SSR device that has a large pickup area, in order to reduce the cleaning time.

[0021] It is yet another aspect of this invention to provide a more effective and efficient way to introduce a chemistry, fluid or cleaner onto a soft surface by use of a low-powered, light-weight, handheld mechanical SSR device.

[0022] It is yet another aspect of this invention to provide a low-powered, light-weight, handheld mechanical SSR device having a slapping mechanism, a dispenser, and a filter that reduces the time required for cleaning, freshening, and disinfecting soft surfaces.

[0023] It is yet another aspect of this invention to provide an easy-to-use, convenient mechanism that encourages consumers to perform touchup cleaning events more frequently.

[0024] Various consumables may aid the device of the present invention in this purpose, for example, disposable filters, scrubbing members, cleaning heads, and various other cleaning materials or fluids. For example, compositions for refreshing fabrics, stain removal and antibacterial control may also be provided.

[0025] These and other aspects of the present invention will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following description, while indicating preferred embodiments of the present invention, is given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] A clear conception of the advantages and features constituting the present invention, and of the construction and operation of typical mechanisms provided with the present invention, will become more readily apparent by referring to the exemplary, and therefore non-limiting, embodiments illustrated in the drawings accompanying and forming a part of this specification, wherein like reference numerals designate the same elements in the several views, and in which:

[0027] **FIG. 1A** illustrates a perspective view of the internal elements of a mechanical SSR device in accordance with a first embodiment of the invention.

[0028] **FIG. 1B** illustrates a side view of the mechanical SSR device of the first embodiment of the invention.

[0029] **FIG. 1C** illustrates a bottom view of the mechanical SSR device of the first embodiment of the invention.

[0030] **FIG. 2** illustrates a flow diagram of a method of performing soft-surface remediation by use of the mechanical SSR device of the present invention.

[0031] **FIG. 3A** illustrates a perspective view of the internal elements of a mechanical SSR device in accordance with a second embodiment of the invention.

[0032] **FIG. 3B** illustrates a side view of the mechanical SSR device of the second embodiment of the invention.

[0033] In describing the preferred embodiment of the invention that is illustrated in the drawings, specific terminology will be resorted to for the sake of clarity. However, it is not intended that the invention be limited to the specific terms so selected and it is to be understood that each specific term includes all technical equivalents that operate in a similar manner to accomplish a similar purpose. For example, the word connected or terms similar thereto are often used. They are not limited to direct connection but include connection through other elements where such connection is recognized as being equivalent by those skilled in the art.

DESCRIPTION OF EMBODIMENTS

[0034] The present invention and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments described in detail in the following description.

[0035] For the purposes of this disclosure, the term "cleaning" or "cleaned" is broadly expanded to include operations associated with soft-surface remediation (SSR). The materials used for further cleaning may include cleaning chemicals, odor eliminators, stain removal, fabric protectors, fresheners, and disinfectants all of which may be in the form of liquids, gases, solids, gels, substrates and/or powders or combinations thereof.

1. System Overview

[0036] The present invention is a handheld mechanical SSR device for, and method of, dislodging, displacing, and disposing of particulates from soft surfaces, such as upholstery. The handheld mechanical SSR device of the present invention effectively performs soft-surface remediation in a non-destructive manner, is low-powered and light-weight, has as large pickup area for providing a faster cleaning operation, provides a chemical delivery mechanism for freshening, disinfection, or assisting in the removal of contaminants, and provides an easy-to-use, convenient mechanism that encourages consumers to perform touchup cleaning events more frequently. For the purposes of this disclosure the term "cleaning" or "cleaned" is broadly expanded to include operations associated with SSR.

2. Detailed Description of Preferred Embodiments

[0037] **FIG. 1A** illustrates a perspective view of the internal elements of a mechanical SSR device **100** in accordance with a first embodiment of the invention. Preferably, mechanical SSR device **100** includes a fan assembly **110**, a filter assembly **112**, a flapper assembly **114**, and a battery assembly **116**.

[0038] In this embodiment, fan assembly **110** further preferably includes a fan motor **120**, which is a standard 5 to 24 volt DC motor or 120 Volt AC motor capable of 1000 to 30000 rotations per minute (RPMs) and a fan blade **122**, which is a standard lightweight fan blade formed of, for example, molded plastic. Fan motor **120** may be either a single-speed or multi-speed AC or DC motor. An example of

fan motor **120** is Mabuchi Motor RS-540SH/SF-5045. Fan assembly **110** is preferably capable of developing a suction pressure of −0.15 to −0.66 pounds per square inch (PSI). However, other fans with similar characteristics are contemplated.

[**0039**] Filter assembly **112** further includes a filter **130** and a collection tray **132**. Filter **130** is a consumable non-woven filter or electrostatic cloth positioned in close proximity to fan blade **122**. Filter **130** can be a standard high efficiency particulate air (HEPA) filter or a high airflow filter (HAF) filter available from 3M. Collection tray **132** is positioned at the lower region of filter **130**, in order to capture large or heavy particles that will not lodge within filter **130** because the suction force is limited. Additionally, when fan motor **120** is turned off and the suction stops, some particles will drop from filter **130** and into collection tray **132**. Filter **130** and collection tray **132** are mechanically integrated such that both may be easily accessed by the user, in order to remove and replace filter **130** and for emptying collection tray **132**. In another embodiment, the filter and the collection tray may be incorporated into the same device. This device may be disposable.

[**0040**] Flapper assembly **114** is preferably a mechanical, surface-slapping mechanism. The assembly **114** preferably includes a set of slappers or flappers **140**, such as a flapper **140***a*, **140***b*, and **140***c*, as shown in **FIG. 1A**, that are arranged parallel to one another and spaced apart, in order to ensure a small air gap therebetween. Flappers **140***a*, **140***b*, and **140***c* are preferably formed of rigid lightweight material, such as spring steel, and include a plurality of holes **142**. Alternatively, each flapper **140** is a solid piece of material that has no holes **142**. In one embodiment, flappers may have a sticky surface or tape on them for catching debris that is freed from the soft surface. Such a tape may be removable and disposed of after capturing debris. This consumable material will need to be replaced before a new cleaning project is started. In another embodiment, protrusions may be added to the flappers either on the tape materials or on the flapper.

[**0041**] Flappers **140***a*, **140***b*, and **140***c* are attached at one end to a spring-loaded hinge **112**, which is mechanically attached in close proximity to filter assembly **114**. Spring-loaded hinge **144** provides a pivot point for flappers **140***a*, **140***b*, and **140***c*. Spring-loaded hinge **144** also provides an appropriate spring force.

[**0042**] Flapper assembly **114** further includes a set of disks **146** that are arranged along a shaft **148**. Disks **146** are oriented orthogonal to flappers **140** and are mechanically coupled to flappers **140** via a set of arms **150**. More specifically, a disk **146***a* is mechanically coupled to flapper **140***a* via an arm **150***a*, a disk **146***b* is mechanically coupled to flapper **140***b* via an arm **150***b*, and a disk **146***c* is mechanically coupled to flapper **140***c* via an arm **150***c*. A standard pulley **152** that is mounted at one end of shaft **148** is driven by a flapper motor **154** via a standard belt **156**. Spring-loaded hinge **144**, disks **146**, shaft **148**, arms **150**, and pulley **152** are formed of a rigid lightweight material, such as molded plastic or aluminum.

[**0043**] Flapper motor **154** is preferably a standard 5 to 24 volt DC motor or a 120 volt AC motor capable of 1000 to 30000 RPMs. Flapper motor **154** may be either a single-speed or a multi-speed DC motor. An example flapper motor **154** is a Johnson Electric HC613G, however, there are a wide range of suitable motors available. When activated, flapper motor **154** imparts rotational motion to shaft **148** and, subsequently, to disks **146**.

[**0044**] Each disk **146** has one or more notches **158**, into which a curved end of its respective arm **150** is alternately engaged and disengaged as each disk **146** rotates. In one example, disk **146***a* and disk **146***c* are mounted on shaft **148** such that their notches **158** are in alignment one to another, while disk **146***b* is mounted on shaft **148** such that its notches **158** are 90 degrees out of phase with those of disk **146***a* and disk **146***c*. However, disk **146***a*, **146***b*, and **146***c* may be mounted with their notches **158** in any user-desired orientation.

[**0045**] If the embodiment is battery powered, the battery assembly **116** preferably further includes a plurality of batteries **160**, which are standard rechargeable or non-rechargeable 1.5 to 9 volt batteries that are electrically connected in series to provide a DC voltage source of 5 to 24 volts to fan motor **120** and flapper motor **152**. Alternatively, the device may be corded and operate via an AC voltage source.

[**0046**] **FIG. 1B** illustrates a side view of mechanical SSR device **100**, which shows that mechanical SSR device **100** further includes a body **170** formed of a rigid lightweight material, such as molded plastic, that houses fan assembly **110**, filter assembly **112**, flapper assembly **114**, and battery assembly **116**. Molded within body **170** is a handle **172**; an opening in that lower region of body **170** forms an inlet **174**. Additionally, a displacement chamber **176** is formed from inlet **174** of mechanical SSR device **100** and leads to filter **130**. Displacement chamber **176** is bounded on two sides by the inner walls of body **170** and, on an upper side near disks **146**, by an airflow guide **178**, which is formed of, for example, molded plastic.

[**0047**] **FIG. 1B** shows that mechanical SSR device **100** further includes a delivery system **180** that preferably includes a chemical supply **182**, which is fluidly connected to a spray pump **184**, both of which are mounted within handle **172**. Spray pump **182** is fluidly connected to a spray nozzle **186** via a tube **188**. Spray nozzle **186** is mounted in the forward region of body **170** in close proximity to inlet **174**. Chemical supply **182** is representative of, for example, a consumable aerosol or liquid canister that contains a substance for freshening, disinfection, or assisting in the removal of contaminants, such as the Oust® Bathroom Air Sanitizer canister manufactured by SC Johnson & Son, Inc (Racine, Wis.). Spray pump **184** is, for example, a manual pump mechanism that has a button that may be manipulated easily by the user's thumb as the user grasps handle **172**. Spray nozzle **186** is the spray outlet for directing the chemical onto the soft surface to be cleaned. Spray nozzle **186** maximizes dispersion and creates very small particles, in order to ensure that the chemistry is properly applied onto, but does not soak, the soft surface. While a fluid cleaner is preferred, it is possible the material dispensed may be a foam, or a powder.

[**0048**] With reference to **FIGS. 1A and 1B**, those skilled in the art will recognize that standard mechanical mounting structures exist within body **170** of mechanical SSR device **100** for securing fan assembly **110**, filter assembly **112**, flapper assembly **114**, battery assembly **116**, and chemical delivery system **180** but, for simplicity, are not shown.

[0049] **FIG. 1C** illustrates a bottom view of mechanical SSR device **100**, which shows the position of flappers **140** in relation to inlet **174**. Inlet **174** is the contaminant pickup area for cleaning a soft surface and also as the air intake port for mechanical SSR device **100**, through which air is drawn by the action of fan assembly **110**. A set of exhaust ports (not shown) are present within body **170** in close proximity to fan assembly **110**. An example dimension of each flapper **140** is 50 to 250 mm long, 20 to 50 mm wide and 3 to 7 mm thick. Holes **142** of each flapper **140** have a diameter of 1 to 7 mm. Note these holes allow dust and dirt that are under the flapper to flow into the body of the unit and then eventually be sucked into the filter. An example dimension of inlet **174** is 1×50 mm. A distance from the end of flappers **140** to the front edge of inlet **174** is typically between 1 and 40 mm. The surface area of each flapper **140** that extends into the area of inlet **174** is, for example, 25×100 mm. Flappers **140** are spaced apart a small distance of, for example, 3 to 10 mm, in order to ensure a small air gap therebetween. Alternatively, a mesh screen or wire material may be used to form the flappers, e.g., in a tennis racket-like configuration.

[0050] With reference to **FIGS. 1A, 1B**, and 1C, the overall dimensions of mechanical SSR device **100** are, for example, a length of between 20 and 40 cm, a width of between 12 and 20 cm, and a height of between 9 and 15 cm. Additionally, an example weight of mechanical SSR device **100** is between 0.9 and 2.0 kg. The overall dimensions and weight of mechanical SSR device **100** are not limited to those stated above, so long as they are practically suited to an ergonomically correct handheld portable device.

[0051] With continuing reference to **FIGS. 1A, 1B**, and 1C, the operation of mechanical SSR device **100** is as follows. A clean filter **130** and a full chemical supply **182** are installed within body **170** of mechanical SSR device **100**. Mechanical SSR device **100** is activated by a standard on/off switch (not shown) that makes an electrical connection between the output voltage of battery assembly **116**, fan motor **120**, and flapper motor **154**. As a result, fan blade **122** rotates and creates a flow of air of between 25 and 50 cubic feet per minute (CFM), by drawing air into inlet **174** in body **170**, through displacement chamber **176**, through filter **130**, past fan assembly **110**, and exiting the air through the exhaust ports at the rear of body **170**. At the same time, flapper motor **154** imparts rotational motion to shaft **148** via pulley **152** and belt **156**. Consequently, disks **146***a*, **146***b*, and **146***c* are rotating, which causes one end of flappers **140***a*, **140***b*, and **140***c*, respectively, to slap up and down. More specifically, and using flapper **140***a* as an example, as disk **146***a* rotates, the curved end of arm **150***a* is alternately engaged and disengaged from one or more notches **158**. When the curved end of arm **150***a* is engaged within a notch **158**, it is lifted upward momentarily, which causes the end of flapper **140***a* that is attached to arm **150***a* also to lift upward momentarily. In doing so, flapper **140***a* pivots upward at an angle away from the plane of inlet **174**, with spring-loaded hinge **144** as the pivot point. As disk **146***a* continues to rotate, the curved end of arm **150***a* disengages eventually from within a notch **158**, which causes arm **150***a* and flapper **140***a* to return to alignment with the plane of inlet **174**, because of the action of spring-loaded hinge **144** and gravity. In doing so, flapper **140***a* slaps against the soft surface to be cleaned and dislodges particles of contaminants within its fibers in a non-destructive manner. This lifting and releasing of flapper **140***a* continues in an alternating fashion as disk **146***a* rotates. As the particles are kicked away from the soft surface because of the action of flapper **140***a*, they are caught in the airflow within displacement chamber **176** and move toward filter **130**. Small particles are trapped within filter **130**, while particles that are too heavy or too large to be trapped within filter **130** hit the surface of filter **130** and then fall into collection tray **132**. Clean filtered air then exits mechanical SSR device **100**. Flappers **140***b* and **140***c* operate identically. However, the slapping action of flappers **140***a*, **140***b*, and **140***c* may be such that they each make contact with the soft surface at different times. Additionally, the repetition rate of flappers **140***a*, **140***b*, and **140***c*, which is determined by the rotational speed of shaft **148** and the diameter of disks **146**, is, for example, between 1 and 10 repetitions/second. As a result, particles of contaminants are dislodged in a non-destructive manner, displaced, and then disposed of. Optionally, by use of spray pump **184**, the user may activate chemical delivery system **180** during the use of mechanical SSR device **100** and, thereby, provide a freshening or disinfection operation, in combination with the removal of contaminants. Upon completion of the cleaning operation, mechanical SSR device **100** is deactivated, filter **130** is cleaned or replaced, collection tray **132** is emptied and, if necessary, chemical supply **182** is replenished.

[0052] Those skilled in the art will recognize that the implementation of flapper assembly **114** as shown and described in **FIGS. 1A, 1B**, and 1C is but one example. Any number of well-known mechanical arrangements is possible for causing a slapping motion of a mechanical element upon the soft surface to be cleaned and, thus, mechanical SSR device **100** is not limited to the specific flapper assembly **114** design disclosed herein. For example, flapper assembly **114** with flappers **140** may be replaced by one or more piston mechanisms arranged orthogonally to the plane of inlet **174**. A piston mechanism is driven to impart an up and down motion to a flat paddle element that is oriented parallel to the plane of inlet **174** for producing a slapping motion upon the soft surface to be remediated.

[0053] **FIG. 2** illustrates a flow diagram of one preferred method **200** of performing soft-surface remediation by use of mechanical SSR device **100** of the present invention. Method **200** preferably includes first the step **210** of retrieving SSR device from storage. In this step, a user retrieves mechanical SSR device **100** from its storage location (which may be a battery recharging device). Method **200** proceeds to step **212**, the step of installing consumables into SSR device. In this step, the user opens the access mechanism for filter **130** within body **170** and installs a new or cleaned filter **130**. If necessary, the user opens the access mechanism for chemical supply **182** within handle **172** of body **170** and installs a new chemical supply **182**. After installing filter **130** and/or chemical supply **182**, the user closes all access mechanisms. Method **200** proceeds to step **214**, the step of activating SSR device. In this step, the user activates mechanical SSR device **100** by a standard on/off switch and, thereby, activates fan motor **120** and flapper motor **154**. As a result, fan blade **122** rotates and creates a flow of air by drawing air into inlet **174** in body **170**, through displacement chamber **176**, through filter **130**, past fan assembly **110**, and out the exhaust ports at the rear of body **170**. At the same time, flapper motor **154** imparts rotational motion to shaft **148** via pulley **152** and belt **156**. Consequently, disks **146***a*,

146*b*, and **146***c* are rotating, which causes flappers **140***a*, **140***b*, and **140***c*, respectively, to slap up and down. Method **200** proceeds to step **216**.

[**0054**] Step **216** is the step of performing the cleaning operation. In this step, the user grasps handle **172** and brings inlet **174** of mechanical SSR device **100** into contact with a soft surface to be cleaned, such as upholstery, and, subsequently, moves inlet **174** of mechanical SSR device **100** over the soft surface to be cleaned by using any back-and-forth or side-to-side motion, until the entire surface has been cleaned by the action of flapper assembly **114** and fan assembly **110**. More specifically, the slapping action of flapper assembly **114** dislodges the particulates, the suction action of fan assembly **110** displaces the particulates by the airflow moving through displacement chamber **176** and toward filter **130**, and the filtering action of filter **130** captures the particulates. Optionally, by use of spray pump **184**, the user may activate chemical delivery system **180** and, thereby, provide a freshening or disinfection operation, in combination with the removal of contaminants. Alternatively, chemical delivery system **180** is automatically activated without direct user activation. Method **200** proceeds to step **218**, the step of deactivating SSR device. In this step, the user deactivates mechanical SSR device **100** by a standard on/off switch, which deactivates fan motor **120** and flapper motor **154**. Method **200** proceeds to step **220**.

[**0055**] Step **220** is the step of removing consumables from SSR device. In this step, the user opens the access mechanism for filter **130** within body **170** and removes the dirty filter **130**. If necessary, the user opens the access mechanism for chemical supply **182** within handle **172** of body **170** and removes chemical supply **182**. Method **200** proceeds to step **222**. Step **222** is the step of preparing SSR device for next use. In this step, the user empties collection tray **132** and, optionally, wipes clean flappers **140** with a cloth. The user then closes all access mechanisms. Next is step **224**, the step of storing SSR device. In this step, the user returns mechanical SSR device **100** to its storage location. Method **200** may then proceed to step **226**. In this optional step, in the case in which batteries **160** are rechargeable batteries, the user plugs mechanical SSR device **100** into an associated battery recharging device. Method **200** ends. Of course, these steps need to not be preformed in the order in which they appear above. Additionally, one of ordinary skill in the art will appreciate some steps need not be present at all and other steps may be added.

[**0056**] **FIG. 3A** illustrates a perspective view of the internal elements of a mechanical SSR device **300** in accordance with a second embodiment of the invention. Mechanical SSR device **300** includes fan assembly **110**, flapper assembly **114**, and battery assembly **116**, as described in reference to **FIGS. 1A, 1B**, and 1C. However, instead of including filter assembly **112** positioned near fan assembly **110**, mechanical SSR device **300** includes a filter **310** in an alternative position relative to flapper assembly **114**, for reasons described in more detail in reference to **FIG. 3B**. Filter **310** is a consumable non-woven filter or electrostatic cloth that is preferably slightly sticky to capture debris.

[**0057**] **FIG. 3B** illustrates a side view of mechanical SSR device **300**, which shows that mechanical SSR device **300** further includes a body **312** formed of a rigid lightweight material, such as molded plastic, that houses fan assembly **110**, flapper assembly **114**, and battery assembly **116**. Molded within body **312** is a handle **314**, an opening in that lower region of body **312** forms an inlet **316** at which filter **310** is mounted. Additionally, a displacement chamber **318** is formed from inlet **316** of mechanical SSR device **300** and leads to fan assembly **110**. Displacement chamber **318** is bounded on two sides by the inner walls of body **312**, on an upper side near disks **146** by an airflow guide **320**, and on a lower side by an airflow guide **322**, which are formed of, for example, molded plastic.

[**0058**] In this embodiment, filter **310** is located at the outside of inlet **316**, in order to facilitate easier access for removal and replacement. Furthermore, this configuration greatly limits any dust and hair from entering mechanical SSR device **300** and reaching fan motor **120** and flapper motor **154**, which reduces the possibility of failure. However, because there is no collection tray **132** within mechanical SSR device **300**, this embodiment is less suited for picking up large or heavy particles and more suited for removing fine particles and hair. More specifically, the media forming filter **310** is slightly sticky and, thus, acts like a piece of tape on a soft surface, to attract and hold the dust and hair. Flappers **140** make contact with the surface of filter **310** opposite the soft surface to be cleaned. The slapping action of flapper assembly **114** enhances the cleaning operation, in order to pick up hair that is entangled within the fibers of the soft surface to be cleaned.

[**0059**] The general operation of mechanical SSR device **300** is similar to that described in reference to mechanical SSR device **100** of **FIGS. 1A, 1B**, and 1C. Additionally, the method of performing soft-surface remediation using mechanical SSR device **300** of the present invention is similar to that described in reference to method **200** of **FIG. 2**. In both cases, mechanical SSR device **300** differs only in the placement and handling of the filter mechanism and the absence of collection tray **132**.

[**0060**] In summary and with reference to **FIGS. 1A, 1B**, 1C, **2**, 3A and 3B, mechanical SSR device **100** and **300** of the present invention effectively perform soft-surface remediation in a non-destructive manner via flapper assembly **114** and fan assembly **110**; are low-powered and light-weight, have a large pickup area (i.e., inlet **174** and inlet **316**, respectively) for providing a faster cleaning operation, provide chemical delivery mechanism **180** for freshening, disinfection, or assisting in the removal of contaminants; and provides an easy-to-use, convenient mechanism that encourages consumers to perform touchup cleaning events more frequently.

[**0061**] In one embodiment, the catch mechanism **130** or consumable non-woven filter, electrostatic cloth or other such material is preferably positioned in close proximity to the fan **110**. Such a disposal mechanism or catch **130** may be a variety of shapes, including, but not limited to, a J-ring, a donut, or a slightly convex or concave cup. The filter may be supported by a plastic or cardboard ring, frame, or housing. In another example, disposal catch mechanism **130** is a Grab-It® Cloth from S.C. Johnson & Son, Inc. (Racine, Wis.) or a Swiffer® Cloth from Procter & Gamble (Cincinnati, Ohio). In yet another example, disposal catch mechanism may be located on or in the tray **132** and may be a non-woven material, a gel, or some sticky substance that will act to trap and hold particulate matter within the air.

[0062] In another embodiment, the flappers **140** themselves may be also impregnated with an active material or ingredient to provide sanitation, such as, odor removal, odor neutralization, or dust mite control, to the soft surface to be cleaned. An example active ingredient for providing sanitation and that has suitably small particles that do not saturate the fabric is triethylene glycol (TEG). An example active ingredient for providing odor neutralization is also triethylene glycol (as found in Oust® from S.C. Johnson & Son). An example active ingredient for providing odor removal is cyclodextrin (as found in Febreze® from Procter & Gamble). Alternatively, this material may be added through the delivery system.

[0063] As mentioned, the fluid or chemical material consumable **182** may include a variety of materials, e.g., cleaners, odor eliminators, fresheners, protectants, and disinfectants all of which may be in the form of liquids, gases, solids, gels and/or powders or combinations thereof. This chemistry is suitable to remediate hard and soft surfaces such as a pillow, mattress, carpet, car interior, drape, window, floor, plumbing drain, insect habitat, and/or couch.

[0064] Additionally, any active material or ingredient may be delivered to the surface being treated by the delivery system **180** which may also include a reservoir or other system that is externally or internally mounted to the unit, and which may include a trigger spray, pump spray, canister, fluid cavity, aerosol, or similar means. Alternatively, the material may be a foam cleaner (contained e.g., in a canister) which after being first set down by an outward flow is then picked up by the device. The foam may be activated by a variety of means as is known in the art, e.g., chemical reaction, surfactants, agitators, a dual bottle system, OXY-CLEAN, etc.

[0065] Materials that both protect and renew also may be added to the fluid stream. These materials can rejuvenate the fibers of the soft surface and coat them to become more dirt resistant and water resistant in the future. For example, various compositions made by DuPont and 3M are known to make fabric water and/or stain resistant, such as SCOTCHGUARD™. These materials may also include compositions comprised of a dispersant and/or microcapsules containing an active material.

[0066] Because of it configuration, this device **100** may be used not only for soft surface cleaning but with minor modification to deliver material that includes an insecticide, repellant, herbicide, fungicide, antimicrobial, floor cleaner, window cleaner, drain cleaner, air freshening, etc. A long, extendable, preferably telescoping, handle allows the user to reach certain surfaces and/or provide distance between the user and the material treating the surface during application. In some instances, the motor is preferably impervious to water so that the device can be used in areas where these types of liquids are used.

[0067] In yet another embodiment, the handle may not be present. This embodiment would be configured to fit into the palm of the user's hand for ease of use in touch-up cleaning particular in areas where is there is not much space.

[0068] Other embodiments of the present invention may have protrusions projecting from the slapper or for the bottom of the housing. These protrusions or teeth may be used to grab on and lift up what is on the surface, e.g., pet hair, paper, or even some other electro-statically bound matter. Alternatively, the teeth may be part of a rake, brush, or they may not resemble teeth at all but rather just a soft, spongy piece of material. The teeth may be more rounded to be more like fingers and may be made of plastic, rubber, or some equally stiff yet somewhat flexible material so as not to damage the surface. Inner housing and motor housing are substantially cylindrical shaped and are formed of a rigid lightweight material, such as molded plastic or aluminum.

[0069] Although the best mode contemplated by the inventor of carrying out the present invention is disclosed above, practice of the present invention is not limited thereto. It will be manifest that various additions, modifications and rearrangements of the features of the present invention may be made without deviating from the spirit and scope of the underlying inventive concept. In addition, the individual components need not be fabricated from the disclosed materials, but could be fabricated from virtually any suitable materials. Moreover, the individual components need not be formed in the disclosed shapes, or assembled in the disclosed configuration, but could be provided in virtually any shape, and assembled in virtually any configuration. Further, although many components are described herein as physically separate modules, it will be manifest that they may be integrated into the apparatus with which they are associated. Furthermore, all the disclosed features of each disclosed embodiment can be combined with, or substituted for, the disclosed features of every other disclosed embodiment except where such features are mutually exclusive.

[0070] It is intended that the appended claims cover all such additions, modifications and rearrangements. Expedient embodiments of the present invention are differentiated by the appended claims.

What is claimed is:

1. A method of cleaning a soft surface comprising the steps of:

mechanically dislodging and displacing of particulates from a soft surface with a handheld device having a slapper;

disposing of the particulates through use of filter in the device; and

disinfecting and freshening the surface with a sprayer containing connected to the handheld device.

2. A handheld mechanical soft-surface remediation device comprising

a housing;

a fan assembly within the housing;

a filter assembly in fluid communication with the fan assembly;

a flapper assembly within the housing;

a battery assembly adjacent the housing; and

a delivery system operably connected to the housing.

3. A method of performing soft-surface remediation by use of the mechanical device comprising the steps of:

retrieving the device from storage;

installing the consumables into the device, activating the device;

performing the cleaning operation with a flapper;

deactivating the device;

automatically activating chemical delivery system without direct user activation;

removing the consumables from the device;

preparing the device for the next use;

storing the device; and

recharging the batteries of the device.

4. A handheld device comprising:

a light-weight housing including a large pickup area;

a motor operably associated with the housing;

a dislodging mechanism driven by the motor for effectively performing soft-surface remediation in a non-destructive manner; and

a means to introduce a cleaner onto a soft surface.

5. A cleaning device comprising:

a housing;

an ingredient delivery mechanism operably associated with the housing for freshening, disinfection;

a flapper assembly in the housing; and

a catch within the housing for the removal of contaminants.

6. A method of performing soft-surface remediation including the steps of:

retrieving from storage from a battery charging position a cleaning device having a body, an inlet, a displacement chamber, exhaust ports and a handle;

installing a consumable into the device by opening a filter access mechanism within the body and installing a new or cleaned filter;

opening a supply access mechanism within handle of body and inserting a new chemical supply;

closing at least one access mechanism;

grasping a handle and bringing inlet of the device into contact with a soft surface to be cleaned;

activating a fan motor to rotate a fan blade and create a flow of air by drawing air into the inlet in body, through the displacement chamber, through filter, past a fan assembly, and out the exhaust ports at the rear of body;

imparting motion to flapper motor to rotate a shaft via a pulley and belt;

rotating disks operably attached to the shaft to cause flappers to move up and down;

slapping the flapper assembly on a surface to dislodge particulates;

moving inlet of device over the soft surface to be cleaned by using a back-and-forth or side-to-side motion;

cleaning a surface by the action of flapper assembly and fan assembly;

displacing the particulates by a suction fan assembly to create an airflow moving through displacement chamber;

moving the particulates toward a filter;

capturing the particulates by a filtering action of filter;

using a spray pump;

activating a chemical delivery system to freshen or disinfect the surface;

deactivating the device by an on/off switch to stop fan motor and flapper motor;

opening the access mechanism for the filter within body to remove the dirty filter;

opening the supply access mechanism within handle of body to remove the chemical supply and recharge the supply;

preparing the device for a next use;

closing all access mechanisms; and

returning the device to its storage location.

7. The device of claim 2, wherein the fan assembly includes a fan motor and a fan blade,

wherein the fan motor includes one of a single-speed or multi-speed AC or DC motor,

wherein the fan assembly is capable of developing a suction pressure of −0.15 to −0.66 pounds per square inch,

wherein the filter assembly includes a filter and a collection tray,

wherein the filter assembly includes a consumable non-woven portion or electrostatic cloth positioned in close proximity to fan blade.

8. The device of claim 2, wherein the filter is at least one of a standard mesh high efficiency particulate air (HEPA) filter or HAF filter.

9. The device of claim 2, further comprising a collection tray positioned near a lower region of a filter in the filter assembly in order to capture particles that will not lodge within filter.

10. The device of claim 2, wherein the filter assembly comprising a filter and a collection tray that are mechanically integrated for ease of access by a user.

11. The device of claim 2, wherein the flapper assembly includes a set of flappers that are arranged parallel to one another and spaced apart to ensure a small air gap therebetween.

12. The device of claim 2, wherein the flapper assembly includes a plurality of flappers that are formed of a rigid lightweight material and include a plurality of holes.

13. The device of claim 2, wherein the flapper assembly includes flappers formed of spring steel;

a disk mechanically coupled to a flapper via an arm;

a pulley mounted at one end of a shaft and driven by a flapper motor via a standard belt; and

a flapper motor that is at least one of a DC motor, an AC motor, a single-speed motor, and a multi-speed motor.

14. The device of claim 2, wherein

the flapper assembly includes a flapper that is a solid piece of material that has no holes;

the flappers are attached at one end to a spring-loaded flapper hinge;

the flapper hinge is mechanically attached in close proximity to the filter assembly;

the hinge provides a pivot point for the flapper;

the spring-loaded hinge provides an appropriate spring force;

the flapper assembly includes a set of disks that are arranged along a shaft; and

the flapper disks are oriented orthogonal to the flappers and are mechanically coupled to flappers via a set of arms.

15. The device of claim 2, wherein when activated, a flapper motor imparts rotational motion to a shaft and, subsequently, to disks.

16. The device of claim 2, wherein the flapper assembly includes a plurality of disks, and wherein each disk has one or more notches into which a curved end of an arm is alternately engaged and disengaged as each disk rotates.

17. The device of claim 2, wherein the flapper assembly includes a plurality of disks are mounted on a shaft such that the notches are in alignment one to another, and wherein at least one disk is mounted on shaft such that its notches are 90 degrees out of phase with those of the other disks.

18. The device of claim 2, further comprising a displacement chamber bounded on two sides by inner walls of a housing body and, on an upper side near disks by an airflow guide.

19. The device of claim 2, wherein the delivery system includes a chemical supply fluidly connected to a spray pump mounted within a handle in the housing; wherein the flapper assembly includes a flapper that slaps against a soft surface to be cleaned and dislodges particles of contaminants within its fibers in a non-destructive manner.

20. The device of claim 5, further including a piston mechanism arranged orthogonally to a plane of an inlet; wherein the piston mechanism is driven to impart an up and down motion to a flat paddle element that is oriented parallel to the plane of inlet for producing a slapping motion upon the soft surface to be remediated.

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