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Abstract: A method of using a filter and a mop bucket comprises removably installing a filter in a mop bucket; filtering a liquid through the filter to capture dirt in the filter; removing the filter from the bucket; connecting a hose to an outlet on the filter; backflushing clean water through the filter; and removably installing the filter in the mop bucket. The filter comprises a first layer of felt and a second layer of felt with a layer of sand is disposed between the first layer of felt and the second layer of felt. A mop bucket comprises a first compartment and a second compartment where the filter is located in a fluid movement path between the first and second compartments.

Declarations under Rule 4.17:

- as applicant’s entitlement to apply for and be granted a patent (Rule 4.1 7(H))
- as to the applicant’s entitlement to claim the priority of the earlier application (Rule 4.1 7(Hii))

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Mop Bucket Filter

This application claims benefit of priority under 35 U.S.C. § 119(e) to the filing date of U.S. Provisional Application No. 61/470,051 as filed on March 31, 2011 which is incorporated herein by reference in its entirety; and this application is a continuation-in-part of copending U.S. Application No. 12/766,197, filed on April 23, 2010 which, in turn, claims benefit of priority to the filing date of U.S. Provisional Application No. 61/256,508, as filed on October 30, 2009 and to the filing date of U.S. Provisional Application No. 61/308,536, as filed on February 26, 2010, which are incorporated herein by reference in their entirety.

Background

Typically a wet mopping process starts with clean water and detergent mixed in the mop bucket to create a cleaning solution. Each time the user finishes mopping a section of the floor the wet mop is dipped in the cleaning solution to remove as much of the dirt from the mop as possible. The excess water and residual dirt may be wrung out of the mop, usually using a wringer. The wrung mop is used again to mop the floor. This process is repeated until the cleaning solution in the mop bucket appears dirty or becomes so dirty that the mop, even after wringing, smears dirt on the floor. Once the cleaning solution is dirty, or is perceived to be dirty, the user pushes the mop bucket back to a janitor closet or other water source. The dirty cleaning solution is emptied out of the bucket and the bucket is refilled with cleaning solution. The user pushes the mop bucket back to the mopping site. The need to interrupt the floor cleaning process and to transport the bucket to empty and refill the bucket wastes chemical detergent, water, energy and increases labor time and costs.
Summary

A method of using a filter and a mop bucket comprises removably installing a filter in a mop bucket; filtering a liquid through the filter to capture dirt in the filter; removing the filter from the bucket; connecting a hose to an outlet on the filter; backflushing clean water through the filter; and removably installing the filter in the mop bucket.

The step of removably installing may comprise connecting the outlet to the mop bucket. The filter may comprise: a first layer of felt and a second layer of felt; a layer of sand located between the first layer of felt and the second layer of felt; a core defining a first plurality of openings supporting the first layer of felt such that fluid may flow from the exterior of the filter to the core; and the outlet communicates with the core. The first layer of felt may comprise a first cylinder and the second layer of felt may comprise a second cylinder where an annular cavity is formed between the first layer of felt and the second layer of felt, and the layer of sand may be located in the annular cavity. The step of filtering may comprise tilting the bucket to allow dirty fluid to pass through the filter. The bucket may comprise a first compartment and a second compartment having a passage communicating the first compartment with the second compartment wherein the step of removably installing comprises connecting the outlet to the passage.

A filter comprises a first layer of felt defining a first cylinder and a second layer of felt defining a second cylinder, the first layer of felt being located inside of the second layer of felt to define an annular cavity between the first layer of felt and the second layer of felt. A layer of sand is disposed in the annular cavity. A core defines a first plurality of openings supporting the first layer of felt such that fluid may flow from the exterior of the filter to the core. An outlet communicates with the core.
The core may define an interior channel through which the fluid flows to the outlet. The first layer of felt may be wrapped around the core and cover the first plurality of openings. The first layer of felt and second layer of felt may be selected from one of 50 micron PET and 50 micron PP. A guard that surrounds the second layer of felt may be provided where the guard comprises a second plurality of openings that allow water to flow through the guard. A third layer of felt may cover the second plurality of openings in the guard. The sand may comprise between a 40/100 and 80/100 Malaysian specification mesh size of sand. The sand may comprise between 725 grams and 900 grams of 60/100 Malaysian specification mesh size of sand. The filter may filter at least 7 quarts of fluid in between approximately 3 and 5 minutes. The filter may be capable of filtering 180 - 220 Nephelometric Turbidity Units to 6 - 16 Nephelometric Turbidity Units.

A mop bucket comprises a bucket defining a first compartment and a second compartment where the bucket is rotatable between an upright position and a second position. A first fluid movement path is provided between the second compartment and the first compartment such that liquid in the second compartment drains to the first compartment under gravity when the bucket is in the upright position. A second fluid movement path is provided between the first compartment and the second compartment such that liquid in the first compartment drains to the second compartment under gravity when the bucket is in the second position. A filter is located in the first fluid movement path comprising a first layer of felt and a second layer of felt and a layer of sand located between the first layer of felt and the second layer of felt.

The filter may be cylindrical. The filter may be releasably secured in the bucket. The first fluid path may comprise a conduit and the filter may comprise an outlet where the outlet is releasably connected to the conduit.
Brief Description of the Drawings

Fig. 1 is a perspective view of an embodiment of a bucket of the invention.

Fig. 2 is a side view of the bucket of Fig. 1.

Fig. 3 is a front view of the bucket of Fig. 1.

Fig. 4 is a back view of the bucket of Fig. 1.

Fig. 5 is a section perspective view of the bucket of Fig. 1.

Fig. 6 is a perspective view of an embodiment of a filter of the invention.

Fig. 7 is an exploded perspective view of the filter of Fig. 6.

Figs. 8, 9 and 10 are a section views showing the operation of the bucket of Fig. 1.

Figs. 11, 12 and 13 are section views showing the operation of an alternative embodiment of the bucket of the invention.

Fig. 14 is a perspective view of the bucket of Figs. 11, 12 and 13.

Figs. 15 and 16 are a section views showing an embodiment and operation of the mop agitator.

Fig. 17 is a detailed perspective view of the agitator of Figs. 15 and 16.

Fig. 18 is a block diagram showing the operation of the bucket of Figs. 5 and 11.
Fig. 19 is a block diagram showing the operation of the bucket of Figs. 1 through 5.

Fig. 20 is a block diagram showing the operation of the bucket of Figs. 11 through 14.

Fig. 21 is a perspective view of an embodiment of the wringer.

Fig. 22 is an exploded view of the wringer of Fig. 21.

Fig. 22A is a perspective view showing the control for the adjustable roller of the wringer of Fig. 21.

Figs. 23 through 25 are perspective views showing the operation of the wringer mechanism of the wringer of Fig. 21.

Fig. 26 is a top view showing the wringer mechanism of the wringer of Fig. 21.

Figs. 27 through 29 are side views showing the operation of the wringer mechanism of the wringer of Fig. 21.

Figs. 30A and 30B are a block diagram showing the operation of the wringer of Fig. 21.

Fig. 31 is a front view of an embodiment of the mop frame.

Fig. 32 is a section view taken along line 32-32 of Fig. 31.

Fig. 33 is a section view taken along line 32-32 of Fig. 31 showing the frame in a partially open position.

Figs. 34 and 35 are perspective views of the mop frame of Fig. 31.
Figs. 36a through 36e are side views of the mop frame of Fig. 31 showing the operation of the frame.

Fig. 37 is a block diagram showing the operation of the mop frame.

Figs. 38 and 39 are perspective views showing alternate embodiments of the agitator.

Fig. 40 is a perspective view showing an alternate embodiment of the filter.

Fig. 41 is a bottom view of an alternate embodiment of a filter.

Fig. 42 is a side view of the filter of Fig. 41.

Fig. 43 is a section view taken along line 43-43 of Fig. 41.

Fig. 44 is a section view taken along line 44-44 of Fig. 42.

Fig. 45 is an exploded section view of the filter of Fig. 41.

Fig. 46 is an end view of the filter of Fig. 41.

Fig. 47 is a perspective view of the filter of Fig. 41.

Figs. 48 and 49 illustrate an embodiment of a method of using the filter of the invention.

Fig. 50 is a partial section perspective view showing an embodiment of the filter mounted in the bucket.
Fig. 51 is a more detailed partial section perspective view showing the embodiment of Fig. 50.

Detailed Description of Preferred Embodiments of the Invention

The mopping system comprises embodiments of a mop, frame, handle, bucket, and wringer as disclosed. While the individual components of the system described herein are useful when used together as part of the mopping system, the components may also be used independently from one another.

Referring to Figs. 1 through 5 the mop bucket of the invention comprises a housing 2 defining an interior space 4 that retains the cleaning solution. While a typical cleaning solution comprises water mixed with a detergent, the term "cleaning solution" as used herein refers to any liquid used for cleaning that may be used with the mopping system of the invention. The housing 2 has an upstanding side wall 8 with an upwardly facing opening formed by rim 6 at top edge thereof. The illustrated embodiment of the bucket 2 has opposed front and back walls 8a, 8b and opposed side walls 8c, 8d although the bucket may have any suitable shape. The user may access the interior of the bucket 2 through the opening defined by rim 6 to fill the bucket with cleaning solution and to insert the mop into the bucket during use of the bucket.

A wringer 200 is located over opening defined by rim 6 such that the mop may be inserted through the wringer into the interior space 4 of bucket 2. The wringer 200 is shown as having a pair of cooperating rollers 220 and 230 that cooperate to wring cleaning solution and dirt from the mop such that the wrung cleaning solution and dirt falls into the bucket. The rollers 220 and 230 may be actuated by a lever 266 to bring the rollers together to compress the mop and wring the cleaning solution and dirt from the mop. While a specific embodiment of a wringer assembly is shown and described with respect to Figs. 21 through 30, the wringer 200 used with bucket 2 may have any
construction and operation that allows the dirty cleaning solution to be wrung into the bucket as will hereinafter be described.

The bucket 2 is divided into two internal compartments by internal divider wall 26. The first compartment is a mop compartment 20 and the second compartment is a filter compartment 22. While the two compartments may be formed integrally with one another as part of a single bucket, the filter compartment may be made as a separate unit from the bucket that is detachable from the bucket such that the bucket may be used without the filter compartment 22. In the illustrated embodiment the internal wall 26 extends across the width of interior space 4 and is connected to side walls 8c, 8d of the bucket 2 with the mop compartment 20 disposed along the front of the bucket and the filter compartment 22 disposed along the back of the bucket. The wall 26 is dimensioned such that the top edge 26a of wall 26 is spaced below the rim 6 of the bucket 2. A cover 27 is secured to the rim 6 of bucket 2 over filter compartment 22 to create a liquid tight seal between bucket 2 and cover 27. As a result, when the bucket is rotated to tilted position (as will hereinafter be described), any liquid in the mop compartment 20 will spill over the edge 26a of the wall 26 and drain from the mop compartment 20 to the filter compartment 22 without spilling from the bucket such that a fluid movement path between the mop compartment 20 and the filter compartment 22 is provided as represented by arrow A. An overspill wall 11 pivots about an axis 13, defined by pins 31 that engage holes 5 in sidewalls 8c and 8d between a retracted position when the bucket is in the upright position (shown in Figs. 5 and 8) to a active position where it overlaps cover 27 when the bucket is in the tilted position (shown in Figs. 9 and 14). The overspill wall 11 prevents the liquid from splashing over the cover 27 and out of the bucket.

The fluid movement path A may comprise tubes, conduits or other passageways, rather than the simple spillway described above, that allow the liquid to drain from the mop compartment 20 to the filter compartment 22.
The bottom 30 of the mop compartment 20 extends below the bottom 32 of the filter compartment 22 such that the bottom 32 of the filter compartment 22 is located at an elevated position relative to the mop compartment 20. The divider wall 26 includes an aperture or a plurality of spaced apertures 34 located adjacent bottom wall 32 such that liquid in filter compartment 22 may drain by gravity through apertures 34 into the mop compartment 20. When the bucket is in the upright position and liquid is in the filter compartment 22 a fluid movement path between the filter compartment 22 and the mop compartment 20 is provided as represented by arrow C that allows the liquid to drain from the filter compartment 22 to the mop compartment 20. The fluid movement path comprises the apertures 34 and the angled bottom wall 32 that drains liquid to the apertures 34. The fluid movement path may comprise tubes, conduits or other passageways that allow the fluid to drain from the filter compartment 22 to the mop compartment 20. The capacity of the mop compartment 20 below the apertures 34 may be approximately the same or slightly less than the capacity of the filter compartment 22 such that the volume of cleaning solution in the mop compartment 20 may be contained in the filter compartment 22.

A mop 23 is inserted into the mop compartment 20 during use of the bucket as shown in Figs. 15 and 16. If a wringer is used, the wringer is positioned such that liquid and dirt wrung from the mop enters mop compartment 20. Referring to Figs. 15 through 17, agitator brackets 17 supporting agitator blades 19a and 19b may be provided in compartment 20 to scrub the cleaning surfaces of the mop 23 and release the dirt off of the mop and into the cleaning solution. Two of the brackets 17 are connected to supports 21 formed on the inside of wall 8a such that they extend into the mop compartment 22 and support blade 19a along the front wall. Two other agitator brackets are connected to the top edge of the divider wall 26 such that they extend into the mop compartment and support blade 19b along the divider wall 26. The brackets 17 may be supported other than as shown provided the agitator blades 19a, 19b extend into the compartment containing
cleaning fluid and are disposed opposite to and face one another. Agitator blades 19a and 19b are submerged below the surface of the cleaning fluid 25 and are spaced such that a mop 23 may be inserted into mop compartment 20 with the cleaning surfaces of the mop disposed in the cleaning solution between the agitator blades 19a and 19b. Each agitator blade 19a, 19b comprises a planar support 27 that is connected to and supported by the brackets 17 and are disposed generally parallel to one another. Extending from the support 27 are a plurality of generally horizontally extending fins 29. The fins 29 comprise thin planar members that extend from support 27 for substantially the width of the support 27. The agitator blades 27 and fins 29 may be formed of molded plastic, rubber or other similar material. The bottoms ends of brackets 17 are formed with flanges 31 and 33 that define a space 43 therebetween. The flanges 29 and 31 surround flanges 35 that extend upwardly from the bottom of the bucket 2 such that the flanges are located in spaces 43. The engagement of the flanges 35 with flanges 31 and 33 fixes the lower ends of the brackets 17 relative to the bucket. Mop 23 can be reciprocated up and down in mop compartment 20 along a first direction B that is transverse to the direction that the fins 29 extend such that the agitator blades 19 contact the mop surface and clean dirt and debris from the mop. The agitator blades 19 also create turbulence in the cleaning solution that also frees dirt and debris from the mop.

An alternate embodiment of the agitator blades 119a, 119b is shown in Fig. 38 and comprises a planar support 127 that is connected to and supported by the brackets 17 and are disposed generally parallel to one another. Extending from the support 127 are a plurality of bristles 129. The bristles 129 may comprise monofilament bristles that extend from support 127 over substantially the entire surface area of the support 127. Referring to Fig. 39, the bristles may also comprise molded rubber bristles 229 that extend from support 227 over substantially the entire surface area of the support as shown in Fig. 39. The agitator blades are spaced from one another a distance sufficient to allow a mop to be inserted between the agitator blades such that
the mop 23 can be reciprocated up and down along a first direction that is transverse to the direction that the bristles 129, 229 extend such that the bristles contact the mop surface and clean dirt and debris from the mop.

Referring to Figs. 3 and 4, a drain 37 may be provided in the bottom of the compartment 20 such that the cleaning solution may be easily drained from bucket 2. The drain 37 may comprise a threaded drain plug 39 that engages a mating threaded hole on the bucket 2.

A filter 40 is shown in Figs. 6 and 7 that comprises a frame 41 comprising a top ring 42 and bottom grid 44. A filtering element 48 is located in the frame 41 such that liquid may flow into filter 40 through top ring 42 and through the filtering element 48 and out of the bottom grid 44. The filtering element 48 may comprise any suitable filter that can remove particles, dirt and debris from the cleaning solution. In one embodiment the filtering element 48 comprises a layer of sand 50. The layer of sand 50 may comprise a .25" thick layer of fine grain sand. Above and below the layer of sand 50 are layers of retaining cloth 52, 54, respectively, such as 5 micron cloth. Above and below the layers of retaining cloth 52 and 54 are layers of wire mesh 56 and 58, respectively, such as .25" wire mesh. An upper grid 46 is located above the wire mesh layer 56 and four layers of 5 micron cloth 60 may be located above upper grid 46. The bottom grid 44 is secured to the top ring 42 by a plurality of screws or other fasteners 62 to sandwich the layers together. The top ring 42 and four layers of cloth 60 form a pre filter. The top ring 42 and four layers of cloth 60 may be eliminated and the upper grid 46 secured to the bottom grid 44 by fasteners 62 such that the upper grid 46 forms the inlet to the filter. The sand layer 50 is maintained in a uniform thickness and in a flat orientation to create an effective water filter. The water is able to freely flow through all of these components. To ensure that all of the liquid flows through the filter elements a liquid tight seal is made between each of the filter elements and the inside wall of bottom grid 44. Referring to Fig. 40 an alternate embodiment of the filter may comprise a cast ceramic or porous plastic filter
140 that comprises a solid body having a plurality of voids 143 formed therein that allow the cleaning fluid to flow through the filter while trapping dirt and debris in the voids.

Another embodiment of a filter suitable for use with the system of the invention is shown in Figs. 41 through 51. The filter 418 may comprise a cylindrical water filter and is used to filter dirty cleaning solution within the mop bucket as described herein. In one embodiment the filter 418 comprises a cylindrical filter element 418a. End caps 415 and 416 close the ends of filter element 418a. An outlet 414 discharges filtered cleaning solution from the filter 418. While the outlet 414 is shown as located at one end of the filter 418 the outlet may be located anywhere along the length of the filter including in the center of the filter. The dirty cleaning solution flows thru layers of filtering media in filter element 418a where most of the dirt is trapped. The filtered cleaning solution then flows out of the outlet 414 to be reused for mopping floors.

Referring to Figs. 43 through 45, the filter 418 comprises a core 402 formed with a plurality of openings 411 that allow the water to flow through the core 402. The core 402 defines an interior channel 412 through which the water flows to and from outlet 414. The end caps 415 and 416 comprise hubs 415a and 416a that are inserted into the channel 412 to form a liquid tight seal therebetween. The core 402 may engage the hubs 415a, 416a with a friction fit or by using adhesive, welding or the like. Hub 415a seals the one end of channel 412. Hub 416a is formed with an interior opening 416c that communicates with manifold 413 such that cleaning solution in the channel 412 may exit the filter via opening 416c, manifold 413 and outlet 414. An inner layer of felt 403 is wrapped around the core 402 to cover openings 411. A layer of sand 404 surrounds the inner layer of felt 413 and is trapped between the inner layer of felt 413 and a middle layer of felt 405 such that the layer of sand has a generally annular shape. The minimum thickness of the layer of sand is preferably at least approximately .375 inches. A guard 406
surrounds the middle layer of felt 405. The guard 406 is formed with a plurality of openings 410 that allow water to flow through the guard 406. The guard 406 is covered by an outer layer of felt 407 that covers the openings 410. The layers of the filter 418 end caps 415 and 416 are arranged such that cleaning solution may not flow from the exterior of the filter to channel 412 except by passing through the filter layers. The ends of the layers may form a liquid tight seal with one another and with the end caps 415 and 416 using friction, adhesive, welding or other sealer or a combination of such mechanisms.

To filter the cleaning solution during use of the mop bucket, the dirty cleaning solution flows into the filter element 418a through the outer layer of felt 407. Next the cleaning solution flows through the openings 410 in the guard 406. The cleaning solution then flows through the middle layer of felt 405. In-between the middle layer of felt 405 and the inner layer of felt 403 the cleaning solution flows through the thickness of sand 404. This thickness of sand 404 traps many of the dirt particulates in the cleaning solution allowing cleaner cleaning solution to flow thru the inner layer of felt 403 and then through the openings 411 in the core 402. The filtered cleaning solution flows along the inner channel 412 to the manifold 413 and out the outlet 414 to the clean cleaning solution reservoir.

Referring to Figs. 50 and 51, to connect the filter outlet 414 to the clean cleaning solution reservoir, the outlet 414 is connected to a conduit 419 that communicates the mop compartment 20 with the filter compartment 22. In one embodiment the outlet 414 comprises two external O-rings 409 where the outlet 414 is dimensioned to be removably inserted into the end of conduit 419. The outlet 414, conduit 419 and O-rings 409 are dimensioned such that the two O-rings 409 create a liquid tight seal with conduit 419 when the outlet is inserted into the conduit. The filter 418 may be removably mounted in the bucket by inserting the outlet 414 into the conduit 419 to force the O-rings 409 into a liquid tight seal between the conduit and the outlet. To remove the filter
418 from the bucket the filter 418 is simply lifted from the bucket to remove outlet 414 from conduit 419. Handles 415d and 416d may be provided such as on end caps 415 and 416 to provide the user a convenient hand hold. The connection between the filter and bucket allows for easy insertion in and removal of the filter and bucket. While a press fit friction connection between conduit 419 and outlet 414 is shown, any suitable liquid tight connection may be used.

With the filter construction described above, larger particles (>50 microns) are trapped by the outer 407 layer of felt and the middle layer of felt 405. The micron specification of this felt could be adjusted higher or lower to trap larger or smaller particulate as required. The smaller particulate (<50 microns) is trapped in the sand 404. A 60/100 mesh size of sand (Malaysian specification) is preferred however a larger mesh of 40/100, 50/100 or a smaller mesh of 80/100 or a mix of sands may be used depending on desired flow rate and clean cleaning solution turbidity. The layers of felt may be 50 micron polyethylene (PET) or polypropylene (PP) fiber felt. The size of the openings in the felt should be selected such that for a given mesh size of sand the sand will not leak through the felt. Our testing shows that the higher the mesh size the slower the cleaning solution flow rate and the lower the resulting clean cleaning solution turbidity (i.e. the filtered cleaning solution looks clearer). Likewise, the lower the mesh size the faster the cleaning solution flow rate and the higher the resulting clean cleaning solution turbidity (i.e. the cleaning solution looks dirtier). Other mesh sizes of sand may be used to optimize the performance of the filter accordingly. Tests performed using the filter 418 testing shows that it takes 2:96 to 5:16 minutes to filter 7 quarts of 180 - 220 NTU (Nephelometric Turbidity Units) dirty water through the filter. The resulting turbidity of the filtered water after passing through the filter is 6 - 16 NTU. Turbidity units do not take into account particle size in the water.
It is preferable to use 725 grams of 60/100 mesh sand; however, between 725 and 900 grams of sand may be used. Too much sand and/or packing the sand too tight can restrict the cleaning solution flow thru the filter. The outer layer of felt 407 acts as a pre-filter to prevent larger particulate from collecting in the openings 410 in the guard 406. The flow rate and clean cleaning solution turbidity can be adjusted by varying the mesh size of sand in the filter, and the entire volume of dirty cleaning solution in the mop bucket is filtered at the same time.

As the filter is used over the course of the work day more and more dirt particles will become captured in the layers of felt and sand. When the filter becomes dirty, such as at the end of the work day, the end user backflushes the filter to clean the dirt particles out of the filter and prepare the filter for the next use. The filter is removed from the bucket by lifting the filter from the bucket such as by pulling on handles 415d, 416d to disengage the outlet 414 from the conduit 419. The removed filter is then flushed with clean water or other solution. Fig. 48 shows a hose 450 being attached to the outlet 414 via threads 417. After the hose 450 is attached to outlet 414 a faucet may be turned on and clean water is backflushed through the filter in a backwards direction, i.e. opposite the direction of flow during filtering as shown in Fig. 49. The dirt particles that were previously trapped in the sand and felt layers are flushed out of the filter and down the drain 451. It is preferable for the end user to rub the outer layer of felt 407 to encourage the release of dirt from the filter. This process may continue for several minutes until the water coming out of the filter during the backflush process runs clean. The hose 450 may then be detached and the filter 414 placed into position in the bucket ready for the next use. One advantage of the filter 414 is that because it is removable from the mop bucket, it can be cleaned during the backflushing process.

The end caps 415 and 416, core 402, and guard 406 may be injection molded plastic. The inner layer of felt 403, middle layer of felt 405, and outer layer of felt 407 may be non-woven polyethylene or polypropylene fiber felt. The inner
layer of felt 403, middle layer of felt 405, and outer layer of felt 407 may be die cut and their respective long edges may be ultrasonically welded to each other to form three felt cylinders at the respective diameters. The inner layer of felt 403 may be slid over the core 402. The ends of the inner layer of felt 403 may be connected to the outside ends of the core 402 such as by ultrasonic welding. Likewise, the middle layer of felt 405 may be inserted inside of the guard 406. The ends of the middle layer of felt 405 may be ultrasonically welded to the inside ends of the guard 406. Core 402 is then connected to end cap 415 such as by hot plate welding. The guard 406 may be connected to end cap 415 such as by hot plate welding. With the filter assembly standing on end with the end cap 415 facing down, 725 grams of 60/100 mesh sand may be poured in the open gap between inner layer of felt 403 and middle layer of felt 405. End cap 416 may be connected to the open ends of inner guard 403 and outer guard 406 by hot plate welding. While filter element 418a as described herein has a cylindrical shape, the filter may have other shapes such as rectangular.

Referring to Fig. 5, the filter 40 or filter 418 is located at the bottom of the filter compartment 22 such that any liquid in the filter compartment 22 flows through the filter 40 or 418 to apertures 34 along fluid movement path C. A liquid tight seal is provided between the filter 40 or 418 and bucket 2 to ensure that all of the liquid flows through the filter. While the filter 40 or 418 is shown at the bottom of the filter compartment 22 the filter may be located at a different position provided the cleaning solution flows through the filter. For example the filter may be centrally located in filter compartment 22 or it may be located in the fluid movement path A between the mop compartment 20 and filter compartment 22, for example, in the spill way defined by the top edge 26a of wall 26 and cover 27. Moreover, the filter is a self contained unit that is removable from the bucket 2 such that the filter can be removed and cleaned and replaced in the bucket.
Referring to Figs. 1 through 4, the bucket 2 is supported on a frame 50 such that the bucket 2 may be pivoted between an upright position, shown in Figs. 1 through 5, to a tilted position, shown in Fig. 9. In the illustrated embodiment, in the upright position the bucket is disposed substantially vertically and the bucket is rotated approximately 90° to a tilted position that is just past horizontal such that wall 26 is inclined slightly downward from the bottom 30 toward fluid movement path A. The frame 50 comprises a first side member 52 connected to a second side member 54 by cross members 56 to create a rigid support structure that supports bucket 2 between side members 52, 54. The frame 50 is supported on swivel wheels 58 such that the frame 50 and bucket 2 may be transported over a floor or other surface by rolling wheels 58.

Extending from each of side walls 8c and 8d are axles 60 that define a horizontal pivot axis a-a for the bucket 2. The axles 60 are supported in pockets or bearings 62 that allow the bucket 2 to pivot relative to the frame 50 such that the bucket may be rotated approximately 90° between the upright position of Fig. 1 and the tilted position of Fig. 9. In the upright mopping position, stops 64 extend from side walls 8c, 8d. Stops 64 engage abutments 66 formed on frame 50 when the bucket 2 is in the upright position to stop the bucket in the upright orientation.

A lock 70 locks the bucket in the upright position to prevent the bucket from inadvertently tilting during use of the mop bucket. The lock 70 comprises a latch 72 that is pivotally mounted on pin 74 to the frame 50 such that it can pivot toward and away from the bucket 2. The latch 72 includes an engagement portion 76 at one end and a pedal 82 at the opposite end that can be depressed by the user to unlock the latch. The engagement portion 78 of latch 72 engages a portion of the bucket such that the bucket cannot pivot relative to the latch when the latch is in the engaged, locked position. In the illustrated embodiment the engagement portion 76 comprises a slot 78 that is engaged by a flange 80 on bucket 2. A spring (not shown) biases the latch 72
to the illustrated locked position. To release the latch 72 the user pushes on pedal 82 to pivot latch 72 about pin 74 such that the engagement portion 76 is rotated away from the bucket and the latch releases flange 80. Once the lock is released the user may manually pivot the bucket to the tilted position about axis a-a in the direction of arrow D. The latch includes a cam surface 84 that is disposed such that when the bucket 2 is rotated from the tilted position back to the upright position (in the direction opposite to arrow D) the flange 80 strikes cam surface 84 to move the latch 72 to the release position. Once the flange 80 becomes aligned with the slot 78 the spring rotates the latch 72 back to the locked position where engagement portion 76 is locked on bucket 2. The pedal 82 is shown located at the bottom of the frame 50 such that it may be operated by the user's foot; however, the pedal could be located elsewhere on the frame and may include an upstanding lever such that it may be conveniently hand operated.

Referring to Figs. 8, 9, 10 and 18 the operation of the bucket will be described. During a typical procedure for mopping a floor the user fills mop compartment 20 with clean cleaning solution 23 (block 1801). The cleaning solution is filled to approximately the drain apertures 34 such that cleaning solution in compartment 20 fills but will not overflow the filter compartment 22 during use of the bucket. The user dips the mop through wringer assembly 200 and into compartment 20 (block 1802). The mop may be scrubbed by agitator blades 19a, 19b to release the dirt off of the mop into the cleaning solution 25. The user removes the mop from compartment 20 and may use wringer 200 to wring excess dirt and cleaning solution from the mop into the cleaning solution in compartment 20. After the user has dipped the mop into the cleaning solution in compartment 20 multiple times the dirty cleaning solution may be filtered clean. To filter and clean the cleaning solution 25, the bucket 2 is pivoted from the upright position of Fig. 8 to the tilted position of Fig. 9 until the mop compartment 20 is disposed over the filter compartment 22 and the cleaning solution is able to drain from the mop compartment 20 to the filter compartment 22 via the first fluid movement path A (block 1803).
While the bucket is described as rotating slightly greater than 90°, the bucket is rotated a sufficient distance to drain the cleaning solution from mop compartment 20 to filter compartment 22 and this distance may be less than 90°. For example, wall 26 may angled such that mop compartment 20 may be drained without the bucket 2 being rotated 90°. As the bucket 2 is tilted, the dirty cleaning solution drains over the dividing wall 26 from compartment 20 into the filtering compartment 22. The cover 27 and overspill wall 11 prevent the dirty cleaning solution from spilling out of the top of the bucket 2. Once all of the dirty cleaning solution has drained into the filtering compartment 22 the user rotates the bucket back to the upright position shown in Fig. 10 (block 1804). At this point all of the dirty cleaning solution 25 is located in the filtering compartment 22. Gravity pulls the dirty cleaning solution through the filter assembly 42 or filter 418 as the filtered cleaning solution follows the second fluid movement path C and drains through apertures 34 and back into compartment 22 (block 1805).

To rotate the bucket 2, the lock 70 is unlocked by moving latch 72 away from the bucket 2 to disengage the engagement portion 76 from the bucket (block 1901). The user rotates the bucket 2 relative to frame 50 from the upright position of Fig. 8 to the tilted position of Fig. 9 allowing the cleaning solution to drain from compartment 20 to compartment 22 (block 1902). To complete the cleaning cycle, the user rotates the bucket 2 relative to frame 50 from the tilted position of Fig. 9 back to the upright position of Fig. 10 (block 1903). The flange 80 strikes the cam surface 84 of latch 72 to move the latch to the unlocked position (block 1904). The bucket 2 is rotated until the flange 80 is aligned with the engagement portion 76 and the latch 72 moves to relock the bucket relative to the frame 50 (block 1905).

Another embodiment is shown in Figs. 11 through 14, where like reference numerals are used to identify like elements previously described with reference to Figs. 1 through 5. The bucket 2 is supported directly on wheels, rather than on frame 50, such that the bucket may be transported by the user.
over a floor or other surface. In the illustrated embodiment wheels 111 are caster wheels that are free to pivot about a vertical axis while wheels 113 are fixed wheels that cannot rotate about a vertical axis although four caster wheels may be used.

A handle 115 extends vertically upward from the bucket 2 such that it can grasped by a user to move the bucket 2. The handle 115 has an internal chamber 120 that extends from the end of the handle near the bucket 2 to a point 116 near the upper free end of the handle 115. The chamber 120 extends to the exterior of the handle 115 at opening 125. A tilting mechanism 130 is disposed in the chamber 120 to facilitate tilting of the bucket. The tilting mechanism 130 comprises a cord 132 that extends in chamber 120 for approximately the length of handle 115 and through opening 125. A tilt knob or grip 134 is secured to the end of the cord 132 that may be easily gripped by the user. The tilt knob or grip 134 is larger than the opening 125 such that the knob cannot be pulled into the chamber 120. In the upright position shown in Fig. 11 the tilting mechanism 130 is stored with the cord 132 retracted into the chamber 120 and the tilt knob or grip 134 pulled against the handle 115 near its free upper end. The user may pull on knob or grip 134 to extend the cord 132 from the handle 115 as shown in Fig. 12. The cord 132 has an enlarged end 136 that is larger than the opening 135 such that the cord 132 may be extended from the handle 115 but cannot be completely removed from the chamber 120. The enlarged end 136 may be weighted such that when the bucket is in the upright position shown in Fig. 11, the weight of the end 136 pulls the end 132a of the cord 132 to the bottom of the chamber 120 thereby retracting the cord into the handle 115 to the retracted position shown in Fig. 11. The extension and retraction of the cord 132 may be accomplished using other mechanisms such as a spool and spring motor or the like.

The bucket in the embodiment of Figs. 11 through 14 operates in the same manner as previously described with reference to Figs. 1 through 10. The method of tilting the bucket in the embodiment of Figs. 11 through 14 will be described. To filter the cleaning solution, the bucket 102 is tilted back until it
is resting on its back on the floor F in the tilted position as shown in Figs. 12 and 14 (block 2001). As the bucket 102 is rotated to the tilted position, the user grabs the tilting knob or grip 134 and pulls the cord 132 out from the bucket handle 115 (block 2002). This causes the weight 136 secured to the end of the cord 132 to slide up the inside of the chamber 120 in the handle 115 until it is stopped at aperture 125. The user can lower and raise the bucket 102 between the upright vertical position and the tilted position without bending over by using cord 132. Once all of the dirty cleaning solution has drained into the filtering compartment 22 via fluid movement path A the user lifts up on the tilting knob or grip 134 and cord 132 which raises the bucket 102 back to the upright position as shown in Fig. 13 (block 2003). The weight 136, under the force of gravity, causes the tilting cord 132 to retract back into the bucket handle 115 which brings the tilting knob 134 back to the retracted position at the top of the handle 115 (block 2004).

The mop bucket 2 allows the user to filter the dirty mop water to create clean cleaning solution whenever and wherever the mop bucket is located without the need to access a clean water source. As a result, the user does not waste time transporting the bucket from the mopping site to a clean water source, emptying the dirty cleaning solution, refilling the bucket with new cleaning solution, and transporting the bucket back to the mopping site. The method and apparatus for mopping and filtering dirty mop water allows the end user to filter the dirty cleaning solution without leaving the job site. The user is able to continue mopping with filtered water quickly and easily.

An embodiment of the wringer of the invention is shown generally at 200 in Figs. 21 through 29 and comprises a housing 202 made of a rigid material such as molded plastic, metal or the like. The housing 202 comprises a pair of side walls 204 and 206 connected by front wall 208 and back wall 210 to define a generally rectangular housing. The housing may have any suitable shape and the shape of the illustrated housing 202 is for explanatory purposes. In one embodiment housing 202 is configured to mate with the top of bucket 2 such that the wringer 200 can be secured to bucket 2. A top 212
covers the housing and defines a relatively large opening 214 for receiving a mop. The bottom of the housing is open such that the opening 214 allows passage through the housing 202 into the bucket. While the wringer shown in Fig. 21 may be conveniently used with the filter bucket 2 of the invention, the wringer 200 may be used with any bucket.

An adjustable roller 220 is mounted between the side walls 204 and 206 such that it may rotate along its long axis. A movable roller 230 is also mounted in the housing 202 parallel to the adjustable roller 220. Roller 220 is rotatably mounted at each end to a cam 222 such that the roller 220 can rotate relative to the cams 222. The cams 222 are used to adjust the position of roller 220 relative to roller 230. The roller 220 is able to move toward and away from movable roller 230 to increase or decrease the space between the rollers and the squeezing force exerted by the rollers on a mop located between the rollers. A control knob 224 is connected to each cam 222 via slots 226 formed in side walls 204 and 206 such that turning the knobs 224 turns the cams 222. The cams 222 are identical such that reference will be made to one cam 222. Cam 222 comprises a plurality of detents 222a formed at spaced intervals about the periphery thereof. In the illustrated embodiment the detents 222a are located every 90°. The cam 222 is eccentric relative to the axis of rotation C-C of the roller 220 such that each detent 222a is spaced a different distance from the axis C-C. To adjust the spacing between the rollers 220 and 230 and the pressure exerted by the rollers on a mop, cams 220 are used to position the adjustable roller 20 relative to movable roller 230. Knobs 224 are rotated causing the cams 222 to rotate relative to the housing to one of four positions 222a. Because cams 222 are eccentrically mounted relative to the axis of rotation C-C of roller 220, roller 220 is moved toward or away from roller 230 when knob 224 is turned. Detents 222a lock the cams 222 in one of the four positions against stop 223 to retain the roller 220 in the desired position relative to roller 230. Slot 226 limits movement of the roller 220 along the length of the slot such that when cams 222 are rotated the roller 220 is moved toward and away from roller 230 along slots 226.
Movable roller 230 has one end mounted to a first end 232a of swing arm 232. The opposite end of movable roller 230 is mounted to a first end 234a of swing arm 234. The opposite end 232b of swing arm 232 is mounted for pivoting movement in side wall 204 and the opposite end 234b of swing arm 234 is mounted for pivoting movement in side wall 206. The mechanism for mounting arms 232 and 234 to the housing are the same such that specific reference will be made to arm 232. Arm 232 has a cylindrical bearing 236 at end 232b that fits into a circular aperture 238 formed in side wall 204. The bearing 236 freely rotates in aperture 238 such that arm 232 can pivot about bearing 236 relative to the housing 202. A cap 240 having an enlarged head 241 is inserted into the bearing 236 and secured to arm 232 to fix the arm 232 to the housing 202 such that arm 232 can rotate but is otherwise fixed in the housing 202. The cap 240 may be press fit into the bearing 236, secured by welding, adhesive or screwthreads or the like.

Referring to Figs. 22 and 26, roller 230 is mounted to the ends 232a and 234a of arms 232 and 234 in the same manner. A toothed gear 242 is fixed to each end of the roller 230 such that the roller 230 and gears 242 rotate together. An axle 244 extends between the arms 232 and 234 such that the roller 230 and gears 242 rotate together on axle 244 about the longitudinal axis of roller 230.

An actuating rod 250 is supported between housing side walls 204 and 206 such that the rod 250 can rotate along its longitudinal axis relative to housing 2. The ends of rod 250 are supported for rotational motion by bearings 253 that are supported in apertures 252 in side walls 204 and 206 such that the axis of rotation of rod 250 is parallel to the axes of rotation of rollers 220 and 230.

Mounted to rod 250 for rotation with the rod are sector gears 260 and 262. The rod 250 may have a rectangular profile that engages rectangular apertures 254 in gears 260 and 262 such that the rod 250 is fixed to the gears. The sector gears 260 and 262 are positioned on rod 250 such that they are disposed inside of the swing arms 232 and 234 directly opposite to
the gears 242. The sector gears 260 and 262 are provided with cam surfaces or bushings 264 that engage the swing arms 232 and 234 to move the roller 230 into engagement with roller 220 as will hereinafter be described. The sector gears 260 and 262 are also provided with gear teeth 263 that engage the toothed gears 242 to rotate the roller 230 as will hereinafter be described.

The end 250a of rod 250 extends through aperture 252 and is connected to lever arm 266. Lever arm 266 is arranged substantially orthogonally to rod 250 and forms a handle that is pushed by the user to rotate rod 250 to actuate the wringer. A spring 259 returns the lever arm 266 and rod 250 to the non-actuated position when lever arm 266 is released by the user. Spring 259 may comprise a coil spring mounted on rod 250 having one end 259a fixed to housing 202 and the opposite end 259b fixed to lever arm 266 for movement therewith.

The operation of the wringer will be described with reference to Figs. 23 through 25, 27 through 29 and 30. A mop is positioned between the rollers 220 and 230 with the top end of the mop, i.e. the end of the mop closest to the handle, between the rollers and the rest of the mop extending below the rollers in a bucket (Block 3001). The wringer 200 is shown in the non-actuated position in Figs. 23 and 27 with the rollers 220 and 230 spaced from one another and lever 266 in the at rest position (Block 3002). Lever arm 266 is rotated by the user in the direction of arrow E causing rod 250 to rotate in the same direction, Figs. 23 and 27 (Block 3003). As rod 250 rotates sector gears 260 and 262 also rotate in the same direction (Block 3004). The cam surfaces or bushings 264 on sector gears 260 and 262 contact arms 232 and 234 that support gears 242 that are fixed to the opposite ends of roller 230 (Block 3005). The cam surfaces or bushings 264 are positioned such that as the sector gears 260 and 262 are rotated, the cam surfaces or bushings 264 force arms 232 and 234, gears 242, and roller 230, toward roller 220 in the direction of arrow F, Figs. 24 and 28. As sector gears 260 and 262 push against the swing arms 232 and 234 the arms are rotated about bearings 236
in the opposite direction F to the direction E of rotation of rod 250 and sector gears 260 and 262 (Block 3006). As swing arms 232 and 234 rotate the movable roller 230 is moved toward the adjustable roller 220 to the position shown in Figs. 24 and 28 where the rollers are in contact or closely spaced from one another.

As handle 266 continues to rotate in the direction of arrow E to the position sown in Figs. 25 and 29, roller 230 continues to swing toward roller 220 until the gear teeth 263 on sector gears 260 and 262 engage the gear teeth on gears 242 (Block 3007). When the gear teeth 263 on sector gears 260 and 262 engage the gear teeth on gears 242, cam surfaces or bushings 264 no longer move swing arms 232 and 234, gears 242, roller 230 toward roller 220 and movement of the roller 230 toward roller 220 stops. The final distance between the rollers 220 and 230 is set by adjustment knobs 224 andcams 222. The engagement of teeth 263 of sector gears 260 and 262 with gears 242 causes roller 230 to rotate about its longitudinal axis in the direction of arrow G as shown in Figs. 25 and 29 (Block 3008). The rollers 220 and 230 exert a compressive force on the mop to squeeze dirt and liquid from the mop and the mopexerts a reactive force on roller 220 causing it to rotate in the direction of arrow H (Block 3009). The direction of movement of the rollers 220 and 230 on the mop is upward away from the bucket in the direction of arrow I such that in addition to squeeving the mop the rollers 220 and 230 also pull the mop upward out of the bucket (Block 3010).

When lever arm 266 reaches its end of travel as shown in Figs. 25 and 29 the user releases the lever arm 266 and the spring 259 returns the lever arm 266 to the non-actuated position of Figs. 23 and 27 (Block 3011). As the lever arm 266 is rotated to this position the rotation of rod 250 and sector gears 260 and 262 is reversed until the gear teeth 263 of sector gears 260 and 262 disengage from the gears 242 (Block 3012). The weight of roller 230 and swing arms 232 and 234 cause the swing arms 232, 234 to rotate downward and away from roller 220 in the direction opposite arrow F (Block 3013).
An alternate embodiment of a mop wringer suitable for use in the current system is disclosed in U.S. Patent Application No. 13/290,289 to Matola et al., filed on November 11, 2011, entitled "Mop Wringer", which is incorporated by reference herein in its entirety.

Referring to Figs. 31 through 36 an embodiment of a mop is shown comprising a handle 301 connected to a frame 302 at a universal joint 303. The frame 302 and components could be stamped metal, molded plastic or wire form or other material. A mop cover 304 is removably secured to frame 302 as will hereinafter be described. The frame 302 comprises of two frame members 307, 308 joined together by hinge 306. The frame members 307, 308 comprise generally planar members that are shaped to create support frame 302 that is sized and shaped to engage and support mop cover 304. Frame member 307 comprises a top side 307c and a bottom side 307d and frame member 308 comprises a top side 308c and a bottom side 308d. Frame member 307 includes a leading edge 307a and a trailing edge 307b and frame member 308 includes a leading edge 308a and a trailing edge 308b. The terms "leading edge" and "trailing edge" are used for convenience in describing the shape of the frame, in actual use either edge may be the front of the mop as the mop is pushed over a surface. In the illustrated embodiment the first frame member 307 and the second frame member 308 have similar shapes; however, the frame members may have different shapes provided the frame 302 fits the mop cover 304. The hinge 306 may comprise a plurality of interdigitated knuckles 309a, 309b formed on the leading edges 307a, 308a of frame members 307, 308, respectively, that are rotatably connected to one another by rods 310 such that the frame members 307 and 308 can rotate relative to one another about hinge 306 between the folded position shown in Figs. 31 and 32 and the collapsed position shown in Fig. 36a.
Mop cover 304 is provided on its top surface 304b with pockets 314 that are engaged by the frame 302 such that the mop cover 304 is retained on frame 302 and covers the bottom side of frame 302. The bottom surface 304a of mop cover 304 is provided with a surface suitable for cleaning a floor or other surface and may comprise an absorbent, abrasive, dust attractive surface or the like. In the illustrated embodiment the pockets 314 are formed at the four corners of cover 304 and receive the four outer corners of frame 302. Pockets may be formed over other parts of the cover 304.

Spaced channels 320 and 322 are provided on the top side of one of the frame members 307, 308. In the illustrated embodiment the channels 320, 322 are provided on top side 307c of frame member 307 and are spaced equally from the center of the frame member 307. Channels 320 and 322 extend between the leading edge 307a and trailing edge 307b of the frame member 307. A yoke 328 is attached to frame member 307 such that the yoke may slide in the channels 320, 322 between the leading edge 307a and trailing edge 307b and may pivot relative to the frame member 307. Specifically, yoke 328 includes a first pin 324 that extends laterally into channel 320 and a second pin 326 that extends laterally into channel 322. The pins 324 and 326 are free to slide along the length of the channels 320 and 322 and to pivot in the channels such that a translating pivot axis c-c, that extends through pins 324 and 326, allows the frame 302 to pivot and translate relative to the yoke 328.

Handle 301 is pivoted to the yoke 328 at pivot 332 such that the handle 301 may pivot relative to the yoke 328 about pivot axis d-d. Axis c-c is orthogonal to axis d-d creating universal joint 303 where the handle 301 may pivot relative to the frame 302 about two perpendicular axes. The universal joint 303 allows the user to use a figure-8 mopping motion and provides the user with a similar ergonomic feel to the figure eight mopping motion of a string mop. The handle 301 may have any convenient length. Further, a handle extension 331 may be releasably connected to handle 301. Handle 301 may
comprise a socket 301a that extends along the length of the handle. Handle extension 331 is releasably inserted into the socket and is locked relative to the handle 301 using any suitable releasable locking device 301b such as a ball and detent, screw threads or the like.

Latches 340 are provided to lock frame member 307 to frame member 308 in the folded position. Latch comprising a first hook 341 formed on frame member 308 that releasably engages a mating hook 343 on frame member 307. The hooks 341 and 343 are deformable such that when frame member 307 is pushed towards frame member 308 the hooks strike each other and deform such that member 341a of hook 341 is disposed behind member 343a of hook 343. The hooks retain the frame members 307 and 308 in the folded position but the frame members 307 and 308 can be forced apart to deform and separate the hooks 341 and 343. The latch may have other configurations and magnets may be used to lock the frame members 307, 308 together.

Slots 344 and 346 are formed in the edges 307b, 308b of frame members 307 and 308 to allow the yoke 328 to pivot relative to the folded frame 302 over 180° of relative motion such that the handle may extend from either side of the folded frame when the opposite side of the frame is disposed on the floor or other surface.

The mop occupies the folded position shown in Figs. 31, 32 and 36c when the mop is in the use position suitable for mopping a floor or other surface. In the folded position, yoke 328 and handle 301 are positioned at the outer ends 320b and 322b of the channels 320 and 322, respectively, and the top side 307c of the first frame member 307 is closely adjacent to and parallel to the top side 308c of the second frame member 308. The frame members 307 and 308 are secured to one another by the latch 340 such that the frame 302 is maintained in the folded position during use of the mop.
The frame 302 occupies the collapsed position shown in Figs. 34 and 36a when the frame 302 is inserted into the mop cover 304 or removed from the mop cover 304. In this position the yoke 328 and handle 301 are positioned at the inner ends 320b, 322b of the channels 320 and 322, respectively, and the first frame member 307 and the second frame member 308 are suspended from the handle 301. The frame members 307 and 308 hang down from yoke 328 such that the bottom sides 307c, 308c of the frame members 307, 308 respectively, are opposite to and face one another but are not connected to one another other than at hinge 6. The frame members 307 and 308 are disposed at an angle relative to one another such that the leading edges 307a and 308a are spaced from one another.

Between the folded position of Figs. 31, 32 and 36c and the collapsed position of Fig. 34 and 36a, the frame 302 may occupy the intermediate expanded position shown in Fig. 35 and 36b. In this position the yoke 328 and handle 301 are positioned at the inner ends 320a, 322a of the channels 320 and 322, respectively. The user can press on the handle 301 in the direction of arrow J to press the frame members 307, 308 against a floor or other surface to force the frame members 307, 308 apart until they occupy the coplanarflat position shown in Fig. 36b. The frame members 307 and 308 are able to rotate relative to one another about hinge 306 between the folded position and collapsed position passing through the intermediate flat position.

In use, the mop cover 304 is laid flat on a floor or other surface, Fig. 36a (block 3701). The frame 302 is in the collapsed position where the frame members 307, 308 are suspended from yoke 328, Fig. 36A (block 3702). The four corners of the frame 302 are positioned opposite the respective four corner pockets 14 of the mop cover 304 (block 3703). The yoke 328 is positioned near the center of the frame 302 at the first end 320a, 322a of the channels 320, 322, respectively (block 3704). The handle 301 is pressed down to flatten the frame 302 and extend the corners of the frame 302 into the pockets 314 of the mop cover 302, Fig. 36B (block 3705). The yoke 328 is
slid from the center position, Fig. 36B, to the edge position, Fig. 36C, where the yoke 328 is moved to the outer ends 320b, 322b of the channels 320, 322 (block 3706). The handle 301 is lifted up in the direction of arrow K to lift the leading edge 307b of frame member 307, Fig. 36D (block 3707). The frame member 307 is then folded about hinge 306 over the frame member 308 in the direction of arrow L, Fig. 36D, Fig. 12 (block 3708). The frame member 307 is secured to the frame member 308 by latch 43, Fig. 36E (block 3709). The mop is then ready for use in the folded mopping configuration. In the folded position a two-sided mop is provided where the handle 301 may extend from either side of the folded frame 302 such that either side of mop cover 304 may be used for cleaning.

To remove the mop cover 304 from the frame 302 the above steps are reversed. The user lifts on handle 301 such that the frame 302 is suspended from the yoke 328 as shown in Figs. 31 and 32. The user pries apart the two frame members 307, 308 to release latch 340. To pry apart frame members 307 and 308 a plunger 360 is mounted in a passageway 361 in the yoke 328 such that the plunger can be reciprocated toward and away from the frame 302. The lower end of plunger 360 is formed with an enlarged head 362 that can be forced between the edges 307b and 308b of frame members 307 and 308 to force the ends of the frame members apart and unlock latch 340 as shown in Fig. 33. The plunger 360 comprises wings 364 that extend out from the sides of handle 301 such that the user can grasp wings 364 and force the plunger 360 down into engagement with the frame members 307 and 308 to the position of Fig. 31. The plunger 360 is raised after the frame members 307 and 308 are separated. When the latch 340 is unlocked the frame opens to the position shown in Fig. 36d. The user moves the handle 301 and yoke 328 to the center position shown in Fig. 36b and lifts the handle such that the frame members 307 and 308 fall down in the collapsed position shown in Fig. 36a. In this position the mop cover 304 falls from the frame 302. The frame 302 provides a two-sided mop that allows the user to attach and remove the mop cover 304 from the frame 302 without touching the mop cover 304.
Specific embodiments of an invention are disclosed herein. One of ordinary skill in the art will recognize that the invention has other applications in other environments. Many embodiments are possible. The following claims are in no way intended to limit the scope of the invention to the specific embodiments described above.
Claims:

1. A method of using a filter and a mop bucket comprising:
   removably installing a filter in a mop bucket;
   filtering a liquid through the filter to capture dirt in the filter;
   removing the filter from the bucket;
   connecting a hose to an outlet on the filter;
   backflushing clean water through the filter; and
   removably installing the filter in the mop bucket.

2. The method of claim 1 wherein the step of removably installing comprises
   connecting the outlet to the mop bucket.

3. The method of claim 1 wherein the filter comprises:
   a first layer of felt and a second layer of felt;
   a layer of sand located between the first layer of felt and the second
   layer of felt;
   a core defining a first plurality of openings supporting the first layer of
   felt such that fluid may flow from the an exterior of the filter to the core;
   and
   the outlet communicating with the core.

4. The method of claim 3 wherein the first layer of felt comprises a first
   cylinder and the second layer of felt comprises a second cylinder where an
   annular cavity is formed between the first layer of felt and the second layer of
   felt, the layer of sand being located in the annular cavity.

5. The method of claim 1 wherein the step of filtering comprises tilting the
   bucket to allow dirty fluid to pass through the filter.

6. The method of claim 1 wherein the bucket comprises a first compartment
   and a second compartment having a passage communicating the first
compartment with the second compartment wherein the step of removably installing comprises connecting the outlet to the passage.

7. A filter comprising:
a first layer of felt defining a first cylinder and a second layer of felt defining a second cylinder, the first layer of felt being located inside of the second layer of felt to define an annular cavity between the first layer of felt and the second layer of felt;
a layer of sand in the annular cavity;
a core defining a first plurality of openings supporting the first layer of felt such that fluid may flow from the an exterior of the filter to the core; and an outlet communicating with the core.

8. The filter of claim 7 wherein the core defines an interior channel through which the fluid flows to the outlet.

9. The filter of claim 7 wherein the first layer of felt is wrapped around the core and covers the first plurality of openings.

10. The filter of claim 7 wherein the first layer of felt and second layer of felt are selected from one of 50 micron PET and 50 micron PP.

11. The filter of claim 7 further comprising a guard that surrounds the second layer of felt, the guard comprising a second plurality of openings that allow water to flow through the guard.

12. The filter of claim 11 further comprising a third layer of felt that covers the second plurality of openings in the guard.

13. The filter of claim 7 wherein the sand comprises between a 40/100 and 80/100 Malaysian specification mesh size of sand.
14. The filter of claim 7 wherein the sand comprises between 725 grams and 900 grams of 60/100 Malaysian specification mesh size of sand.

15. The filter of claim 7 wherein the filter filters at least 7 quarts of fluid in between approximately 3 and 5 minutes.

16. The filter of claim 15 wherein the filter is capable of filtering 180 - 220 Nephelometric Turbidity Units to 6 - 16 Nephelometric Turbidity Units.

17. A mop bucket comprising:

a bucket defining a first compartment and a second compartment, said bucket being rotatable between an upright position and a second position;

a first fluid movement path provided between the second compartment and the first compartment such that liquid in said second compartment drains to said first compartment under gravity when said bucket is in the upright position;

a second fluid movement path between the first compartment and the second compartment such that liquid in the first compartment drains to the second compartment under gravity when the bucket is in the second position; and

a filter located in the first fluid movement path comprising a first layer of felt and a second layer of felt and a layer of sand located between the first layer of felt and the second layer of felt.

18. The mop bucket of claim 17 wherein the filter is cylindrical.

19. The mop bucket of claim 17 wherein the filter is releasably secured in the bucket.
20. The mop bucket of claim 17 wherein the first fluid path comprises a conduit and the filter comprises an outlet, the outlet being releasably connected to the conduit.
FIG. 10
1801 FILL MOP COMPARTMENT WITH CLEANING SOLUTION

1802 DIP MOP INTO MOP COMPARTMENT

1803 TILT BUCKET AND DRAIN LIQUID FROM MOP COMPARTMENT TO FILTER COMPARTMENT VIA FIRST FLUID MOVEMENT PATH

1804 ROTATE BUCKET TO UPRIGHT POSITION

1805 DRAIN LIQUID THROUGH FILTER AND FROM FILTER COMPARTMENT TO MOP COMPARTMENT VIA SECOND FLUID MOVEMENT PATH

FIG. 18
1901: Unlock bucket from frame

1902: Rotate bucket relative to frame to tilted position

1903: Rotate bucket from tilted position to upright position

1904: Bucket moves latch to unlocked position

1905: Latch moves to relock bucket to frame

FIG. 19
TILT BUCKET TO REST ON FLOOR

GRAB TILT KNOB OR GRIP AND EXTEND CORD FROM HANDLE

USE CORD TO LIFT BUCKET TO UPRIGHT POSITION

RETRACT KNOB OR GRIP INTO HANDLE

FIG. 20
POSITION MOP BETWEEN ROLLERS

ROLLERS ARE SPACED FROM ONE ANOTHER AND LEVER IS IN REST POSITION

ROTATE LEVER AND ROD IN FIRST DIRECTION

ROTATE SECTOR GEARS IN FIRST DIRECTION

CONTACT MOVABLE ROLLER GEARS WITH CAMS ON SECTOR GEARS

CAM'S FORCE MOVABLE ROLLER TOWARD ADJUSTABLE ROLLER USING SWING ARMS

A

FIG. 30A
GEAR TEETH ON SECTOR GEARS ENGAGE GEARS ON MOVABLE ROLLER

SECTOR GEARS ROTATE MOVABLE ROLLER

ROLLERS COMPRESS MOP AND MOP EXERTS REACTIVE FORCE ON ADJUSTABLE ROLLER

ROLLERS PULL MOP UPWARD AWAY FROM BUCKET

SPRING RETURNS LEVER TO NON-ACTUATED POSITION

REVERSE MOVEMENT OF SECTOR GEARS TO DISENGAGE FROM GEARS ON MOVABLE ROLLER

MOVABLE ROLLER ROTATES AWAY FROM ADJUSTABLE ROLLER

FIG. 30B
3701 PLACE MOP COVER ON A SURFACE WITH POCKETS EXPOSED

3702 FRAME IN COLLAPSED POSITION, SUSPENDED FROM YOKE

3703 POSITION FRAME ADJACENT POCKETS ON MOP COVER

3704 POSITION YOKE IN CENTER OF FRAME

3705 FLATTEN FRAME AND EXTEND FRAME INTO POCKETS

3706 MOVE YOKE TO EDGE OF FRAME

3707 LIFT EDGE OF FRAME MEMBER

3708 FOLD FIRST FRAME MEMBER OVER SECOND FRAME MEMBER

3709 USE LATCH TO SECURE FIRST FRAME MEMBER TO SECOND FRAME MEMBER

FIG. 37
B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**IPC(8):** B08B 3/14 (2012.01)

**USPC:** 134/1 10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**USPC:** 15/260, 15/261, 15/262, 15/263; 134/1 10; 210/473, 210/477, 210/489, 210/492

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

*PubWEST*(PGPB,USPT,USOC,EPAB,JPAB); Google Patents, Google, PAIR

Search terms used: filter, sand, felt, cylindrical, tubular, layers, mop, bucket, hose backflushing, flushing, annular cavity, core, openings, perforated, outlet, inlet, quarts, grams, fluid, Nephelometric Turbidity

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>US 4815160 A (SMITH) 28 March 1989 (28.03.1989); Figs 1-2; col 3 in 39-50; col 4, in 25-40; col 5 in 44-65; col 6 in 1-10; col 9, in 9-16</td>
<td>1-6 and 17-20</td>
</tr>
<tr>
<td>Y</td>
<td>US 2,906,403 A (TRUAX) 29 September 1959 (29.09.1959); col 1, in 57-66; col 2, in 43-60; col 5, in 1-20; claim 5</td>
<td>3-4 and 7-20</td>
</tr>
<tr>
<td>T</td>
<td>US 201/1/0100929 A1 (LANDINGHAM et al.) 5 May 2011 (05.05.2011) entire document</td>
<td>1-20</td>
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</table>

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
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