Title: IMPROVED WASHER METHOD AND APPARATUS

Abstract: An improved washer using a cold wash for clothing that heretofore was hand washed or dry cleaned, is provided. The cold water can be made by refrigeration. The washer includes a drum and basket which spins fast enough to "pin" the clothes to the basket. The wash water and soap, is then sprayed through the clothes to clean the same. The non-tumbling non-agitating, pinned, spray washing with cold water wash and rinse permits clothes, usually dry cleaned or hand washed, to be machine washed with the present invention without use of hazardous chemicals or shrinkage. The washer may also include drying apparatus and method utilized cold air and the "pinned" in place concept.
IMPROVED WASHER METHOD AND APPARATUS

This application is a United States Patent Cooperation Treaty (PCT) claiming the benefit and priority on United States Provisional Application, Serial No. 60/857,086, filed November 6, 2006 of the same title and by the same inventor, therein relates to a method and apparatus for washing clothes and particularly relates to a commercial washer apparatus and method for minimizing shrinkage and capable of "pinned in place," no tumbling - no agitation, cold water alternative washing to conventional ("perc") dry cleaning of fine clothes.

Background of the Invention

It is known to wash clothes with a washing machine, and these machines generally operate with several cycles conventional such as "Regular Wash" and "Gentle Wash". In either cycle the washing machine's wash drum, tub or compartment has to be filled and emptied with wash water, and one or usually more rinses all the while tumbling or agitating the clothes in the usually hot or warm water. While washing is done in "cold" water, usually unheated from the city, village or well supply, and at a temperature anywhere from 70°F in summer to 50°F in winter. Such temperatures and actions can contribute to shrinkage of the clothes.

Further, there are certain types of material or clothing which presently have to be dry cleaned or hand washed. An example of such material or clothing are fine silks, woolens and even leathers or furs. If washed in a prior art washing machine (which prior art does not include my below mentioned co-pending washer or dryer applications), these fine silks, woolens or other fine clothing or leather or furs would not come out satisfactory, would distort, shrink or become smaller in size and/or would likely result in a customer complaint.

Summary of the Present Invention

There are some cold water washers, such as my non-prior art, co-pending U.S. provisional washer application, Serial No. 60/446,928, filed February 12, 2003, succeeding co-pending PCT application, Serial No. PCT/US03/12156, (WO 2004/072354 A1 - Publication) filed April 18, 2003 and my U.S. National Phase Serial No. 10/545,503, filed August 12, 2005. These washers used a form of tumbling or agitation.
There is a non-prior art dryer, such as my non-prior art, co-pending U.S. provisional dryer application, Serial No. 60/428,424, filed November 22, 2003, succeeding co-pending PCT application, Serial No. PCT/US03/037490, (WO 2004/048673 A3 - Publication) filed November 21, 2003 and my U.S. National Phase Serial No. 10/535,789, filed May 22, 2005.

Portions of these PCT applications are herein incorporated by reference and attached herein as appendix A and B hereto.

The present invention provides a method and apparatus for a washer that provides and washes clothes at lower temperatures, and minimizes or eliminates tumbling and agitation. In the present invention, during washing the clothes are held in place or "pinned" to the washer basket or drum with centrifugal force and not tumbled or agitated. That is, given the washer basket size and diameter, it is rotated fast enough to generate centrifugal force to hold the clothes in place on the basket. To achieve the washing action the clothes or material are not agitated or tumbled through a pool of water, but instead the wash water is sprayed or otherwise conveyed with soap or detergent through the clothes "pinned" in place on the washer basket to clean them. Generally the water and soap flows from the inside or center of the basket, through the pinned clothes, and then collected and removed from the drum. The water and soap may be recovered, filtered or otherwise cleaned and recycled through the clothes until clean. The rinse occurs in similar matter, wherein the washer water is drained and the new rinse water is similarly sprayed through the pinned clothes, without agitation and/or tumbling. Several rinses may be used. Additionally, prior to the washing cycle, the clothes may be distributed (to achieve balance and a uniform distribution of the load) by slower speed rotation (a form of tumbling - but without water) so that the clothes are generally equally distributed about the circumference of the rotating basket or drum. Here the speed is not high enough to "pin" the clothes in place. The present invention makes it possible to wash materials that heretofore were usually commercially dry cleaned.

The washer of the method and apparatus of present invention can, if desired, be built to do a "regular" and/or "gentle" wash cycle, but it is also capable of washing as described above of forms of fine clothing, such as woolens, rayons, silks and acetates and even leathers or furs, that heretofore, were hand washed or only dry cleaned. In order to accomplish this desired task, the washer method and apparatus of the present invention is provided with a very cold water source,
say under 50°F, and preferably around 40°F, say plus or minus 5°F, and yet further preferably around 33° plus 5°F. The advantage of the very cold water wash is that it minimizes distortion or shrinking of the clothing being washed as does the pinning of the clothes in place. The sprayed, very cold water, wash with a suitable soap or cleaning chemical and the pinned, non-agitation, non-tumbling wash action can replace dry cleaning done with environmentally hazardous "perc".

To supply the very cold water, the city or public water supply flows into an insulated tank which can have a wash and rinse water sections or compartments. A means is provided for cooling the wash and rinse water flowing into or in the tank and/or to be supplied to the washer at these desired very cold temperature. This means for cooling could take the form of chiller means, including refrigerator means for cooling water. Various means could be used such as a heat exchanger, a refrigeration unit, icemaker, ice or the like to keep the water in the wash and rinse tanks and washer basket and drum cold. The cooling could take place before the tanks or before the washer basket or chamber, but preferably takes place before the tanks so that a simple means for cooling the cool water for both the washer and rinse section of the tank or separate washer tanks and rinse tank. This very cold water can be recirculated from the wash chamber (basket/drum) to the wash or rinse tank to the cooling means used again to keep the water cold. Again, such may be in the form of a pipe or line taking wash or rinse water from the washer chamber and cooling it and returning it to the washer chamber. Such means can be a pump for recirculating flow and heat exchanger in a separate chilling or cooling tank, and may have a separate cooling or refrigerating means.

The very cold wash concept integrates with the no tumbling/no agitating ("pinned clothes") wash concept to achieve the desired no shrinking washing. To reduce operating costs the water tanks and connecting lines or pipes can also be insulated to prevent heating of the water. This construction decreases the energy required by the refrigeration or other means providing the very cold water. The "pinned" clothes concept is somewhat similar to that used in my above mentioned provisional dryer application(s), Serial No. 60/428,424 filed November 22, 2002 and Serial No. 60/467,627 filed May 2, 2003 and succeeding co-pending U.S. PCT application, Serial No. PCT/US2003/37490, filed November 21, 2003 for a dryer, wherein the "pinned" action is used for part of the drying cycle, and imitates "blocked" drying.
The method and washer of the present invention, if desired, can also be provided with hot water from a conventional hot water heater or the heater integrated into the washer tank.

The washer and method of the present invention may also incorporate the drying operation and apparatus in my above co-pending PCT dryer applications. Thus, the washer and method of the present invention can do a wash that is an alternative to dry cleaning, and if desired a regular hot, warm or cold wash, a gentle hot, warm or cold wash.

**Brief Description of the Drawings**

Figure 1 is a schematic view of the washer of the method and apparatus of the present invention.

**Description of the Preferred Embodiments**

Referring to Figure 1, a schematic of the washer method and apparatus of the present invention is shown. Shown in Figure 1 is the washer 10 with washer chamber means or drum 12.

It is understood the cylindrical drum 12 has a cylindrical side wall 13 and end walls 14, one of which has an opening for a door to permit loading and unloading of clothes into and from the washer. Inside the washer 12 drum is a washer basket 15 indicated by the dashed line. The washer basket 15 can rotate or move relative to the drum 12 as represented by the arrow 20. As shown, the basket 15 is rotated by a basket motor 15A, the operation of which is controlled via a connection 15B by a controller 70. The drum 12 is understood to be able to collect, contain and then discharge wash water or rinse water for reuse or draining. The motor and drum and basket are capable of, given their size, to be operated at high enough speed to pin the clothes to the basket with centrifugal force.

A conventional water supply, including water from the public supply and, optionally a hot water heater, are provided and represented by the line 9. The supplies 9 can be used for the conventional regular and conventional gentle cycle washes, if such is provided.

Above the drum 12 is a fill means for filling the water supply tanks 30 (including wash tank 30W and rinse tank 30R), which preferably is mounted at the top of the washer to provide gravity flow of water for washing and/or rinsing. While gravity flow could be used, the fill means could also be a forced flow such as via the city water pressure or a pump means for the washer/rinse means, and could also be used alone or in conjunction with the gravity flow. The
supply tank 30 could be sized to hold and supply all the water for at least one complete wash cycle including rinse cycle. For example, with a washer sized for a 50 lb. load, each of the components 30W and 30R of the tank 30 could be say about 20 gallons. One of the advantages of the washer of the present invention is that it uses say from 25 to 33 percent less water than conventional washers. This less water usage is particularly advantageous in that use of less water means the use of less energy needed to cool the wash or rinse water to the desired cold temperate, and if a conventional washing is also provided, less for heating.

The tanks 30 (30W and 30R) are connected via a fill line 40 (including 40W and 40R) to a very cold water tank means 50.

The very cold water tank 50 can be filled by the line 54 connected to the outside or public water supply 9. The water tank 50 is connected to a cooling means 60 for cooling the water, such as the evaporator or cooling coil 62 of a refrigerating unit 64. The function of the cooling means 60, evaporator or coil 62, and refrigerating unit 64, or the like is for providing the very cold water inside the water tanks 50, 30 (30W and 30R) and washer. To control the operation of the cooling means and/or refrigeration unit, a control means 70 and connector 64A is provided for regulating temperature. A water temperature sensor or thermocouples 72 are provided and used to regulate the refrigeration unit. This control means 70 would control the operation of the cooling means 64 to assure and provide the water therein is at a desired temperature. It should be understood that the controller 70 could be a programmable central processing unit used to control all the motors, pumps and valves of the washer to provide essentially automatic operation. The constructions of such controller and its programming are believed within the skill of the art and needs no further description.

The washer includes a supply 1 for soaps and detergents used during washing, and a supply 2 for sizing, conditioners and starches used during a rinse. These supplies can just feed or pump in the required product at the required time and could also be controlled by controller 70, via lines S1 and S2.

Preferably, some form of re-circulation such as a pump 80 and pump motor 81 could be provided to cause circulation from the tanks 30 (30W and 30R) and washer drum 12 and basket 15 back through the water chiller 50. As noted, means 70 could also be used to control such operation and re-circulation, say operated in response to the thermocouples or programming as noted. When desired, the tanks 30W and 30R and drum 12 can be drained of the water through
and via a line 74 and a drain valve 76 which can connect to the main drain line 77. These valves too can be connected to the controller 70 and controlled by the same.

Additionally, a recirculation supply system 80 with its control valves 82 and 83 are connected via line 90 to the chiller tank 50 and the water tanks 3OW and 3OR, back to the basket 15 and drum 12. This line connects to a circulating means 84, such as a pump 80, 82, for circulating very cold water from the tank 30W or 3OR to the washer drum 13 via line 91, button trap 92, line 99, and valve 82, pump 80 and line 90. Again all these valves and motors can be connected to the controller 70 and controlled by the same, by connections 81A, 82A, 76A, 83A.

The cold recirculation system includes the cold water return line 91, connecting, in this instance, to a conventional commercial washer filter/button trap 92. From there a line 91A connects to a control valve 96 therein and in turn past the cooling coil, or recirculating heat exchanger or cooling coil 62 within the chiller tank 50. The ends of the cooling coil 62 connect, via refrigeration or cold fluid lines 100 and 102. Thus, with valves 76 closed and valves 82 and 83 open, water can be taken from the wash chamber 12, via line 91, the button trap 92, valve 82, lines 99, the pump 80 and line 90 and valve therein back to the chiller tank 50. Again if desired, a suitable temperature sensing means can also be provided for the wash chamber and control means 70 connected provided to control the various valves and motors to insure the wash is done at a desired, controlled temperature, with recirculation both in the wash and rinse cycle and drains as needed.

Thus, in a wash cycle, the clothes are put in the basket 15, the door is closed, the washer's control system 70 such as the control computer activated. The wash chamber 12 is supplied with water from the city supply 9, chiller 50, tank 30W (for a wash) and tank 3OR (for rinsing), going through, for example, the appropriate fill, wash, drain, fill, rinse, drain, fill rinse and drain cycles. These cycles are more fully described in my incorporated and attached co-pending PCT washer application, Serial No. PCT/US2003/12156. If the very cold water, "pinned" in place wash as described is used, fine woolens and other fine fabrics like silk, and even leathers or furs can be cleaned without hand washing or use of "perc" or other environmentally hazardous chemical cleaners without shrinking.

For regular hot water washing, hot water can be used for the wash and generally city water would be used for rinsing. For nominal cold water washing, city water would be used for both washing and rinsing. For very cold water washing, substitute for dry cleaning, very cold water may be used for both washing and rinsing.
It should be understood that this very cold water wash system could be adapted to and provided to work with an existing type conventional washer. In such a situation the necessary parts can be provided in "kit" form for installation on such existing washer or the Figure 1 embodiment could be and preferably is a stand alone unit. However, preferably the apparatus of the present invention is specially built.

During the wash or rinse portions the recooled water can flow via line 84 to a line 100 and open valve 102 through line 104 to be sprayed through one or more nozzles 106 into or back into the wash chamber 12 and the clothes therein. Thus, the Figure 1 embodiment could be and preferably is a stand alone unit.

The wash cycle might be:

Fill 180 sec.
Wash 360 sec.
Drain 60 sec.
Fill 180 sec.

Rinse 120 sec.
Drain 60 sec.
Fill 180 sec.
Rinse 120 sec.
Drain 60 sec.

for total of 1320 seconds, to a wash cycle of:

Fill 10 sec.
Wash 360 sec.
Drain 20 sec.

Fill 10 sec.
Rinse 120 sec.
Drain 20 sec.
Fill 10 sec.
Rinse 120 sec.

Drain 20 sec.

for total of 690 seconds.
Preferably the washer of the present invention is sized for a load of clothes and would have a basket drum near conventional proportions. Say for a fifty pound load the drum could be about 42 inches in diameter say plus or minus 5 inches with the basket of about 40 inches in diameter and say plus or minus 5 inches. The drum could be of a length of 12-24 inches with about 18 preferred, the basket 10-22 inches with 16 inches preferred. With such a size basket the clothes balance or distribution speed might be say 30 rpm plus or minus 20 rpm, with the clothes "pin" speed of 120 rpm plus or minus 20 rpm. The basket in addition is capable of an extraction or spin cycle wherein most of the water is removed from the clothes prior to drying. This extraction speed with this size drum could be from 300-800 rpm.

Now in addition to a washing function, the unit can also carry out a drying function and to that extent, the drying apparatus and drying method is like that described in my co-pending and attached PCT drying application, Serial No. PCT/US/2003/37490.

During the initial "balance" cycle at the start of a wash cycle the basket may be rotated at a slower speed where some tumbling is introduced and then reversed in the direction of rotation one or more times, say less than 4 to spread the clothes out along the interior surface of the basket. Such may be at speeds accelerated from a stand still to say toward 30 rpm plus or minus 20 rpm. A balance cycle could also be conducted during a wash or rinse cycle should the drum become out of balance using conventional sensors on the drum mechanism to signal the control means 70 that rebalancing is needed.

Overall the cycle would be:

Load
Balance
Wash with Recycle
Drain

Rinse with Recycle
(optimally a drain and a second or more rinse cycles)
Rebalancing as needed
Final Drain
Extraction

Drying per PCT/US2003/37496
Another useable cycle would be load, balance (reverse rotations with cold air only being supplied) 3-5 minutes, wash 4-5 minutes, rinse 2-3 minutes, extractor 2-3 minutes, and drying as in my above PCT dryer application.

The drying operation would be conducted. To facilitate drying the refrigeration unit 64 can also supply cold refrigerant or cold water to a cooling coil in a cold or cooler 200. The coolant or refrigeration being supplied and returned by lines 202 and 204 respectively to an evaporator or cooling heat exchanger 206 in the cooler 200. In the path of the air flow 210 through the air cooler 200 is a heater 214 unit for supplying heated air. Preferably the heater unit 214 is downstream of the cooler 210. Appropriate valving or controls 200A and 214A are provided for and in the cooler 200 and heater 214 to provide cool or hot air as needed, and preferably as called for in my incorporated and attached co-pending PCT dryer application, Serial No. PCT/AUS2003/37490 all of which can be connected at lines 216 and 218 to the control means 70 and operated by the same.

To draw air out of the washer/dryer basket 15 and drum 12 for drying the clothes an intake air duct 220 is provided and goes through an air lint trap filter 224 into the intake of a fan 228. The fan 228 has a motor 229 also controlled by the controller 70 via connections 229A. The air is then heated or cooled depending on what portion of the drying cycle is occurring as per the above PCT application. The air is returned to the washer/dryer chamber 13 by a duct 230.

The heating of the air by heater 214 could be by steam, electricity, gas, etc.

The air to initially dry the clothes could be less than 60°F to about 40°F.

Further, the washer method and apparatus of the present invention can clean (wash and dry) fine clothing such as those made out of woolens, rayon or acetates, leathers, fiirs, etc. which previously had to be hand washed and/or dry cleaned say with "perc" or other clothes previously only hand washed.

The washer shown has the motor drive 15A to rotate the basket and a control unit 70 to operate the various valves 9A, 40WA, 40WR, 102W, 102R, 82, 83, 76 and motors 15A, 64, 81, 229 as needed for the various portions of the wash and dry cycle. If desired, the motor 15A may rotate the basket in either direction of rotation particularly for the balance cycle. It is believed that the specifics of such control operations of the valves and motor drive would be known to person's skilled in the art from the disclosure herein and particularly the flow paths shown herein. All this could be provided in a new washer specially constructed, or adapted to an existing washer by installing the necessary new parts, such as from an installation kit. As used herein
clothes, includes all forms of clothes and the materials or cloths whether in the form of clothes or not.

The equivalent of the elements and steps described above of the present invention are understood to be included herein and within the scope of the appended claims.
IMPROVED WASHER METHOD AND APPARATUS

This United States PCT application is a continuation-in-part of United States provisional patent application Serial No. 60/446,928 filed February 12, 2003, by the same inventor on which claim of priority is made. This invention relates to a method and apparatus for a clothes washer and particularly relates to a "quick" type washer for commercial or domestic use additionally capable of cold water alternative washing to conventional ("perc") dry cleaning of fine clothes.

Background of the Invention

It is known to wash clothes with a washing machine, and these machines generally operate with several cycles such as "Regular Wash" and "Gentle Wash". In either cycle the washing machine's wash drum, tub or compartment has to be filled and emptied many times with say wash water, and one or usually more rinses. Generally the wash cycle is made up of fill, wash, drain, fill, rinse, drain, fill, rinse and drain times. The fill and drain times with present washing machines can comprise 50% or more of the entire wash cycle. For example, if a full wash cycle takes 30 minutes, the fill and drain times can amount to more than 15 minutes. Thus, if a laundry is to do an ascertained amount of laundry per hour beyond what one machine can do to keep up with customer demand, additional washers are necessary.

Further, there are certain types of clothing which presently have to be dry cleaned or hand washed as present washing machines do not permit them to be washed therein. An example of such wash, are fine silks, woolens and even leathers or furs. If washed in a prior art washing machine these fine silks, woolens or other fine clothing or leather or furs would not come out satisfactory, would distort, shrink or become smaller in size and/or would likely result in a customer complaint.

Summary of the Present Invention

The present invention provides a method and apparatus for a washer that has a considerably shortened cycle time and can generally do about two loads of wash in the time one load of wash would be done in a prior art washer. The present invention achieves the increased washing capacity without reducing the actual washing action or
wash time. Instead, the washer apparatus and method of the present invention provides extremely quick filling and quick draining of the wash chamber to essentially shorten the overall wash cycle. To achieve these results, a quick fill means for filling and a quick drain for draining the wash chamber means of the washer is provided. For example, filling can be reduced from three (3) minutes to fifteen (15) seconds or shorter, say 10 seconds, while draining can be reduced from sixty (60) seconds to fifteen (15) seconds or shorter, say 10 seconds. In prior art washers, draining was controlled by the public water supply pressure (say normally 80 psi) and the smallest size pipe from there to the washer. This pipe was usually about one inch or less in diameter and limited the supply or fill rate resulting in slow filling. However, this normal pressure is not always available and can be considerably lower when several washing machines or other devices are using water at about the same time. If the normal city water pressure were 80 psi, the pressure in the laundry at the washer could be 30 psi or lower, greatly slowing filling times. Likewise, the drain was limited by the size pipe used to drain the washer. This was usually about a two inch diameter pipe or less.

The washer method and apparatus of the present invention achieves a quick fill by providing a quick fill tank above the washer which can be constantly filled by the public water supply if needed, but via a large diameter pipe or pipes say two pipes of two inches in diameter or more used to quickly fill (15 seconds or less) the wash chamber. Another alternative is to provide a single large diameter pipe say of 3 or 4 inches or more in diameter between the quick fill tank and wash chamber with a drain flow area of greater than 3 and preferably 4 square inches in area. Of course the inlet pipe or pipes would be fitted with a suitably sized fill control valve(s), preferably controlled for operation either by pneumatic, hydraulics or electrical means. For example, if the wash chamber requires 10 gallons, the quick fill tank might be sized for 30 gallons or more to hold all the water for the entire wash cycle, including the wash and all rinses. The quick fill tank of course would be refilled during the entire wash cycle. The quick fill tank could fill the washer chamber by gravity, but as a preferred alternative, or in addition, a quick fill pump could be supplied to do so. If a quick fill pump is used, it may be desirable to close the fill tank so it can be pressurized by the pump to achieve a short fill-time. In addition, if the pump is used, the tank bottom can be funnel shaped and of a smaller size, say 5 gallons as the
pump and its pressure will still achieve a quick fill. In addition an appropriate storage tank or reservoir tank means is provided so that the quick fill pump can draw from such storage tank or reservoir tank means and is not dependent on the slow fill rate of the city water supply.

A quick drain is also provided from the wash chamber to the public sewer system. Usually laundries are required to have a drain tank into which the washers are drained. In the present invention the drain flow path from the wash chamber to the laundry drain tank is sized larger than heretofore to permit a very quick drain (15 seconds or less). For example, the drain might consist of several two inch diameter or larger drain pipes or a single yet larger drain pipe. Again, suitable drain control valve or valves are provided in the washer to control the drain as required by the various washer cycle. While "diameters" are mentioned, the inlet and drain pipes could be of other shapes than round cross-section.

The washer of the method and apparatus of present invention can not only do a "regular" and/or "gentle" wash cycle, it is also capable of washing some forms of fine clothing, such as woolens, rayons, silks and acetates and even leathers or furs, that heretofore, were hand washed or only dry cleaned. In order to accomplish this additional task, the washer method and apparatus of the present invention is provided with a very cold water source, say under 50°F, and preferably around 40°F, say plus or minus 5°F. The advantage of the very cold water wash is that it minimizes distortion or shrinking of the clothing being washed. The very cold water wash with a suitable soap or cleaning chemical can in many cases replace dry cleaning done with environmentally hazardous "perc".

To supply the very cold water, the city or public water supply flows into a large insulated tank which is several times larger than the quick fill tank and even the washers washing chamber. A means is provided for cooling the water flowing into or in the tank and/or to be supplied to the washer to the desired very cold temperature. This could take the form of chiller means or refrigerator means for cooling water. Various means could be used such as a heat exchanger, a refrigeration unit, icemaker, ice or the like to keep the water in the washer cold. The cooling could take place before the tank or before the washer chamber, but preferably takes place in the tank. This very cold water can be
recirculated from the wash chamber to the cold tank or cooling means to keep the water cold. Again, such may be in the form of a pipe or line taking wash or rinse water from the washer chamber and cooling it and returning it to the wash chamber. Such means can be a pump for recirculating flow and heat exchanger in the cooling tank, or even a separate cooling or refrigerating unit. Again, as discussed above, the filling and draining of the wash chamber can, if desired, be done very quickly (15 seconds or less).

The very cold wash concept integrates into the quick wash concept so that the desired features of both can be realized. To this end, like the cold water tank, the quick fill tank, and connecting lines or pipe are also insulated to prevent heating of the water and to decrease the energy required by the refrigeration or other means providing the very cold water.

The method and washer of the present invention can also be provided with a similar hot water quick fill tank which can be filled from a conventional hot water heater or the heater integrated into the hot water tank. Also, if desired, a third tank at city water temperature could be provided for conventional washing and rinses.

Thus, the washer and method of the present invention can do a regular hot, warm or cold wash, a gentle hot, warm or cold wash, along with an alternative to dry cleaning, a very cold water wash, and the latter could also optionally include a very cold water or city water rinse.

Further to enhance the washing action the inner basket of the wash chamber may have increased surface area such as by providing fins and/or raised inwardly or outwardly embossments on the cylindrical surface and end wall of the basket. The function of the increased surface area is to enhance the washing action on the clothes therein in a gentle but positive manner, without causing undo turbulence which might damage fine clothing and their buttons, while enhancing water flow area such as on a rinse or extraction cycle. This type embossed basket could also be used in a dryer.

**Brief Description of the Drawings**

Figure 1 is a schematic view of the water supply and flow used in the method and apparatus of the present invention.

Figure 2 is a schematic perspective view of the washer for the method and
apparatus of the present invention.

Figure 3 is a schematic view of an alternative washer flow portion for the method and apparatus of the present invention.

Figure 4 is a schematic perspective view of the embossed washer basket for the method and apparatus of the present invention.

Figure 4A is an enlarged cross-sectional view of a portion of the basket 600's cylindrical wall or shell 602 and end wall 604 with openings 606 therethrough and inward and outward embossments 612 thereon.

Figure 5 is a schematic time diagram of the fill, wash rinse drain cycles of a conventional washer (TOP) and of the quick fill, wash, rinse, quick drain cycles of the washer method and apparatus of the present invention (BOTTOM).

Figure 6 is a perspective view from the top of another embodiment of the washer apparatus and method of the present invention.

Figure 7 is a further perspective view of the washer shown in Figure 6.

Figure 8 is a front view of the washer shown in Figures 6 and 7.

Figure 9 is a schematic of water flow for additional embodiment having 3 tanks, no quick fill tank, a single pump and a plurality of control valves.

Figure 10 is an operating chart for some of the conditions of the embodiment shown in Figure 9.

**Description of the Preferred Embodiments**

Referring to Figure 1, a schematic of the water flow system of the method and apparatus of the present invention is shown. Shown in Figure 1 is the washer 10 with washer chamber means or drum 12. It is understood the cylindrical drum 12 has a cylindrical side wall 13 and end wall 14, which has an opening for a door (similar to opening 220 and door 219 of Figure 2) to permit loading and unloading of clothes into and from the washer. Like a conventional washer, a conventional water supply, including water from the public supply and a hot water heater are included and represented by the lines 9 and 11 with control valves 9A and H A therein. The supplies 9 and 11 are used for the conventional regular and conventional gentle cycle washes. The drum 12 is understood to be able to contain wash water or rinse water. It should be understood that
pipes or lines 9 and 11 and their valves could also be of an existing conventional washer.

Inside the washer 12 drum is a washer basket 15 (also see Figure 2, part 218 and Figure 4, part 600). The washer basket 15, 218 or 600 (represented by dashed lines in Figure 1) can move relative to the drum 12 as represented by the arrow 20. As is noted below (with respect to Figures 4 and 4A) this washer basket 15 can be embossed to increase surface area and liquid flow area.

Above the drum 12 is a quick fill means for filling the water supply tank 30, which preferably is mounted at the top of the washer for a gravity fill of drum 12. The quick fill washer means includes a line 32, comprising either several conventional size pipes (several say two inches in diameter or large pipes) or a single large diameter pipe (say three inches in diameter or larger) and an associated quick fill valve 34. The function of the quick fill line(s) 32 and quick fill valve(s) 34 is to quickly fill the drum 12 by gravity flow with an appropriate quantity of wash or rinse water, much faster (say 8 or more times faster) than in prior art washers. While gravity flow is used, the quick fill means could also be a pump forced flow such as via a quick fill pump means for filling the washer means, and could also be used alone or in conjunction with the gravity flow. The supply tank 30 is provided with vent line 36 and vent valve 38, to permit quick drain of the supply tank 30 and quick fill of the drum 12. The vent would be omitted if a quick fill pump is used to prevent flow therefrom. The supply tank 30 is sized to hold and supply all the water for at least one complete wash cycle, and preferably somewhat more, say one to two complete wash cycles.

As was noted above, the quick fill tank can be funnel shaped to enhance filling for said wash chamber, and can be closed so it can be pressurized by the pump if one is used to increase flow therefrom, and if a pump is used, made smaller than or eliminated, if only gravity flow were used.

The supply water tank 30 is connected via a fill line 40 to a storage or reserve very cold water tank means 50. This fill line 40 and line 54 is of conventional size, say one half inch diameter pipe or line. The reserve tank is several times larger than the supply tank, say two to three times, and many times larger (3 to 6 or more) than the water required in the drum for a wash or rinse. For example, for a nominal 50 lbs. clothing washer, the supply tank might be 30 to 50 gallons, with about 40 gallons preferred, and
the reserve tank of 60 to 100 gallons, with about 80 gallons preferred. These sizes may vary by say ± 25% of the total gallons of water used in a wash cycle. Generally, the wash cycle water usage would be that required in the fine clothing, very cold water wash cycle discussed below. If that cycle is not included, then the regular wash cycle could be used in sizing components.

The reserve or storage very cold water tank 50 itself, might be shaped somewhat like a large hot water heater with insulation on the outside surface of the tank 52. The reserve water tank 50 can be filled by the line 54 connected to the outside or public water supply represented by the arrow 56. Inside the reserve water tank 50 is a cooling means 60 for cooling the water, such as the evaporator 62 of a refrigerating unit 64 or other cooling means, like ice or the discharge of an ice maker. The function of the cooling means 60, evaporator 62, and refrigerating unit 64, or the like is for providing very cold water inside the reserve water tank 50. To control the operation of the cooling means and/or refrigeration unit, a control means 70 for regulating temperature such as a water temperature sensor or thermocouple 72 is provided and connected to the refrigeration unit via a control line 73. This means would control the operation of the cooling means to assure the water therein is at a desired temperature. A similar water control means 75 could be provided in the quick supply tank 30 to be sure the water therein is appropriately "cold," and if not, replaced by cold water from the reserve tank 50. Likewise, this control 75 could be a thermocouple and would be used to determine if circulation of very cold water from tank 50 was needed. As noted in the other embodiments, the washer could have additional tanks for hot water and city water at the public or city water supply temperature.

While shown near the bottom of the tank, the cooling means 60 might be located at the top of the reserve water tank 50 to take advantage of the phenomenon of warmer water rises to the top then cools and fall to the bottom to provide some circulation in the reserve tank. Alternatively, some form of circulation such as a pump or impeller could be provided to cause circulation within the tank 50. As noted, means could be used to control such circulation, say operated in response to the thermocouples as noted. When desired, the reserve water unit 50 can be drained via a line 74 and a reserve tank drain valve 76 which, though not shown, can connect to the main drain line 77.
Additionally, a recirculation supply line 80 with its control valve 82 is connected to the reserve water tank 50. This line connects to a circulating means 84, such as a pump 86, for circulating very cold water from the reserve water tank 50 to fill the supply tank 30, via line 84, valve 85 and line 88.

The cold recirculation system includes a cold return line 90, connecting, in this instance, to a commercial washer, conventional, button trap 92. From there a line 94 connects to a control valve 96 therein and in turn to a cooling coil, or recirculating heat exchanger 98 within the reserve tank 50. The other end of the cooling coil connects, via a line 100, to the line 80. Thus, with valves 76, 77A, and 85 closed and valve 96 open, water can be taken from the wash chamber 12, via line 90, the button trap 92, valve 96, lines 94, cooling coil 98 line 100, and line 80 to the pump 86. From there, the recooled water can flow via line 84 to a line 100 and open valve 102 through line 104 to be sprayed through one or more nozzles 106 back into the wash chamber 12 and the clothes therein. Again if desired, a suitable temperature sensing means can also be provided for the wash chamber and controls provided to insure the wash is done at a desired, controlled temperature.

Thus, in a wash cycle, the clothes are put in the basket 15, the door (like 219) is closed, the washer's control system activated, such as a computer control, the wash chamber 12 is filled from the quick fill tank 30 going through the appropriate fill wash, drain, fill rinse, drain, fill rinse and drain cycles. If the very cold water is used, fine woolens and other fine fabrics like silk, and even leathers or furs can be cleaned without hand washing or use of "perc" or other environmentally hazardous chemical cleaners.

For regular hot water washing, hot water can be used for the wash and generally city water would be used for washing and rinsing. For nominal cold water washing, city water would be used for both washing and rinsing. For very cold water washing, a substitute for dry cleaning, very cold water may be used for both washing and rinsing.

It should be understood that this very cold water wash system could be adapted to and provided to work with an existing type conventional washer. In such a situation the necessary parts can be provided in "kit" form for installation on such existing washer.

Referring now to Figure 2, another embodiment of washer 200 of the method and apparatus of the present invention utilizing the features discussed above is shown. This
embodiment has the washer structure 210, including a washer chamber 214 with basket 218 therein, closed by a door 219 fitting in the aperture 220. To one side of the washer structure 210 is a reserve very cold water tank 224, somewhat like tank 50 of Figure 1. On the other side is the hot water tank 230. This tank 230 could also be in the form of a hot water heater having water heating means or just a hot water storage tank. The tanks 210 and 230 are rectangular in cross sections and can form part of the washer 200. The very cold water tank 224 can supply water to its own quick fill cold water tank 240. The hot water tank 230 has its own quick fill hot water tank 244 and can supply water to the same. Each of the quick fill tanks (240 or 244) can quickly fill the wash chamber via lines 248 and 249 in about 15 seconds or less, say 10 seconds. The structure of Figure 2 is also provided with the quick drain lines 250 and 252 which can quickly empty the wash chamber to the drain tank 260 in 15 seconds or less, say 10 seconds. The very cold or hot water can be transferred from their respective tanks to their respective quick fill tanks by pumps. The cold water side would be equipped with suitable water cooling means, such as discussed with respect to the Figure 1 embodiment. Thus, the Figure 2 embodiment could be a stand alone unit. Again, the quick fill could be by gravity but preferably is facilitated by a pump to quickly pump water from the tank to fill the chamber. The quick fill tank in that case can be either smaller and/or shaped as a funnel and have a funnel shape bottom, or even eliminated. In the latter case, the pump would pump water from the respective storage tank 224 or 230 into the wash chamber 214. To achieve the quick fill for increasing the water level, such pump would need to be driven by a one or more horsepower motor, say a 2 or 3 horsepower motor, and to achieve the desired quick flow rate, say 10 gallons or more in 10 seconds.

Referring to Figure 3, another washer 300 of the method and apparatus of the present invention is shown. This embodiment has a wash chamber 304 with a basket (like 214 or 600) therein, and is connected to a single quick supply tank 310. The quick supply tank can be supplied from either a very cold supply tank 316 or a hot water tank 320. The cold water tank 316 would have the water cooling system therein and has the recirculating cold water system including the refrigeration or cooling coil 324 connected via line 326 with valve 328 therein, button trap 330 and line 332. The other end of the cooling coil is connected via line 334 to a recirculation pump 336. The pump 336 in turn is connected
to line 338 to supply a nozzle 340 or other means to return the recooled water to the chamber 304 and clothes therein.

Cold water can be supplied to the reserve cold water tank 316 by city water line 54. Water can be supplied to the hot water tank 320 by line 54A which may be connected either to a conventional water heater, or if the tank 320 has its own water heating means, to the city water supply. The quick supply tank 310 has a vent 350 with a vent valve 352 therein. Hot water can be supplied from tank 320 to the quick fill tank 310 by flow of water through line 360, open valves 362A, valve 364 being closed, through lines 365 and 365A by a fill pump 368, which pumps the hot water up through line 370 into the tank 310. Very cold water can be supplied to the quick fill tank 310 by closing valve 362 and 362A and opening valve 364 and 364A, so that very cold water can flow from tank 316, through line 365A to line 365 moved by pump 368, which can pump the very cold water into tank 310. The quick fill tank 310 is quickly emptied via one or more fast flow lines 360 and opening quick fill valve 364 therein, the cross sectional area of this line or lines 360 and valve or valves 364 being such to provide the desired quick fill rate. The wash chamber 304 can be quickly drained by closing valve 328 and opening valve 77A to permit the water to quick flow through line 332, button trap 330, open valve 77A and line 77 to the drain or drain tank. Again the drain lines are sized to give the desired fast drain rate. Again, if desired, a properly sized pump 368 (say of several horsepower) could be utilized to achieve the quick fill means for increasing the water level of either the very cold water from tank 316 or hot water from tank 320, and the tank 310 could be reduced in size or eliminated, as would be the vent 350 and vent valve 352.

Referring to Figure 4, an embossed washer basket 600 is shown which can be used and is part of the method of the present invention. The washer basket 600 fits within the wash chamber (say 12 or 304), and can rotate or spin therein and has a cylindrical shell 602 with an end wall 604. The shell 602 and end wall 604 can have a multitude of small passages or openings 606 therethrough for flow of water. As noted above, the function of the raised portions or embossments 612 are to provide increased surface area and flow area by also providing fins 608 on the inside and/or raised or indented inward and/or outward on shell 602 and end wall 604 embossed portions 612 on the surfaces of the basket with additional water flow passages therethrough. These embossed portions 612
increase the action of the moving basket on the clothes therein in a gentle but positive manner without endangering fine clothes or their buttons. There is also some increase in the drainage area through the basket, particularly on a spin, rinse or extraction cycle. This embossed basket concept can also be utilized in other type laundry machines than washers, such as in a dryer basket to increase the surface area and flow of drying air in and out of the basket to improve drying.

Referring to Figure 4A an enlarged cross-sectional view of a portion of the basket’s 600 cylindrical wall or shell 602 and end wall 604, showing openings 606 or the small passages for the flow of water, and the embossed portions 612 formed on the surface of the basket.

Referring to Figure 5, a time diagram shows the time for a prior art washer cycle in column 710 and the present invention washer apparatus and method time for a wash cycle in column 720. It can be seen the invention results in shorter overall wash cycle time without reduced washing action time or rinsing action time. This advantage is due to the quick fill and quick drain features described above. In Figure 5, the horizontal represents time and "F" stands for fill, "W" stands for wash, "D" stands for drain and "R" stands for rinse. While not shown, the cycles could also include extraction or spin cycles.

As is apparent, the overall cycle time for the invention is shorter and about half compared to a prior art washer. Where a prior art wash cycle might be

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<td>Fill</td>
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<td>Wash</td>
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<tr>
<td>Drain</td>
<td>60 sec.</td>
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<tr>
<td>Fill</td>
<td>180 sec.</td>
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<tr>
<td>Rinse</td>
<td>120 sec.</td>
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<tr>
<td>Drain</td>
<td>60 sec.</td>
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for total of 1320 seconds,

For a wash cycle with the present invention, the times are

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<tr>
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<td>Operation</td>
<td>Duration</td>
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<tr>
<td>Wash</td>
<td>360 sec.</td>
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<tr>
<td>Drain</td>
<td>20 sec.</td>
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<tr>
<td>Fill</td>
<td>10 sec.</td>
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<tr>
<td>Rinse</td>
<td>120 sec.</td>
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<tr>
<td>Drain</td>
<td>20 sec.</td>
</tr>
<tr>
<td>Fill</td>
<td>10 sec.</td>
</tr>
<tr>
<td>Rinse</td>
<td>120 sec.</td>
</tr>
<tr>
<td>Drain</td>
<td>20 sec.</td>
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</table>

Thus it is apparent that the washer method and apparatus results in greatly reduced overall wash cycle time, without diminished wash or rinse time or action. Further, the washer method and apparatus of the present invention can clean fine clothing such as those made out of woolens, rayon or acetates, leathers, furs, etc. which previously had to be hand washed and/or dry cleaned say with "perc" or other clothes previously only hand washed.

Referring to Figures 6 and 7, another embodiment of the washer method and apparatus of the present invention is shown. In this embodiment where structure is similar to that of the earlier figures, it is given a similar reference number, but use a 700 series. For example, the drum 12 of Figure 1 would be 712 in Figures 6 and 7. Shown in Figures 6 and 7 is the washer 710 with washer drum 712.

It is understood that cylindrical drum washer 712 has a cylindrical side wall 713 and end walls and one of which, the front, has an opening for a door (similar to opening 220 and door 219 of Figure 2) to permit loading and unloading of clothes into and from the washer. Like a conventional washer, a conventional city water supply, including water from the public supply and a hot water heater are included. The public or city supply water and water heater are used for the conventional regular and conventional gentle cycle washes. The drum 712 is understood to be able to contain wash water or rinse water.

Inside washer 712 drum is a washer basket (like 600), not shown. The washer basket can move or turn in either direction relative to the drum 712. As noted above this washer basket can be embossed to increase surface and flow areas.

Above the drum 712 is a closed quick water supply tank or funnel 730, which
preferably is mounted at the top of the washer for, preferably, a pressurized fill of the drum 712 by a quick fill pump 787 and line 787A. A quick fill line 732, comprising either several conventional size pipes (several say two inches in diameter or large pipes in this instance) or a single large diameter pipe of four inches diameter or larger, alternatively, an associated quick fill valve (not shown) can be provided to connect the tank or funnel 730 to the drum 713.

The function of the quick pump 787 and fill lines 732 and, if present, quick fill valve, is to quickly fill the drum 712 by pressure pump or gravity flow with an appropriate quantity of wash or rinse water, much faster (say 8 or more times faster) than prior art washers. When gravity flow is used, the tank would be vented. When a forced flow such as via a pump is used, no vent is provided, and the tank is closed except for an entrance and exit therefrom.

As noted, in the gravity flow version, the supply tank 730 is provided with vent (not shown) and vent valve, to permit quick drain of the supply tank 730 and quick fill of the drum 712. The supply tank 730 can be sized to hold a supply all water for at least one complete wash cycle, and preferably somewhat more, say one to two complete wash cycles.

In the pump filled version, tank 730 would not be vented, is capable of being pressurized by the fill pump 787 no fill valve is needed, and can be of smaller size or eliminated.

The washer 710 has the three water tanks 750 A, B and C and is enclosed in a suitable housing (see Figure 8). The washer mechanism including drum 712 is mounted on a base structure 779 in a frame 781. The washer mechanism in the frame includes the washer motor 782 which carries a drive pulley 783, which via belts 784, drive the driven pulley 784A. The frame 781 mounts the washer mechanism on a plurality of springs 785 with shock absorbers 786 to limit vibrations. In addition, the embodiment 710, has a digital control 777 which controls the operation of the refrigerator unit and its compressor 765 and pump(s) and/or circulating means 787, and all other features and functions of the washer and the various wash cycles. Lines for injecting soap into the drum 712 are shown at 790 and 791. To control and show water levels in the tanks, a triple water level gauge is shown at 792, one for each tank. In addition, multiple bin means 794 are provided to
add solid type soaps, conditioners, etc. on the front of the washer.

The fill water tank 730 is connected via line 751 to a reserve very cold water tank 750A, a city water tank 750B and a hot water tank 750C. Each of the reserve or storage tanks 750A,B and C are several times larger than the supply tank and can quickly fill the top supply tank 730 and washer drum 713 with the desired quantity of coater. For example, a nominal 50 lbs. of clothing washer, the quick, supply tank might be 5 or less gallons, with each of the reserve tanks 750A,B, C of 60 to 100 gallons, with about 80 gallons preferred. The sizes may vary by say ± 25% of the gallons used in a wash cycle. Generally the wash cycle water usage for sizing purposes would be that required in the fine clothing very cold water wash cycle discussed below. If that cycle is not present then the regular wash cycle could be used.

Additionally, the washer of the present invention could be built in larger or smaller sizes to handle say 75 lb. or 35 lb. (measured dry) loads of wash. Each of the reserve water tanks 750A, B and C might be shaped somewhat like a large hot water heater with insulation on the outside surface 752 of the tanks. For compactness, these tanks may be rectangular in shape. Inside the reserve water tank 750A is a cooling means 760 for cooling the water, not shown, such as the evaporator coil of a refrigerating unit 765 or other cooling means, like ice or the discharge of an ice maker. The refrigeration unit includes a compressor. The function of the cooling means 760, evaporator, and refrigerating unit, or the like is for providing very cold water inside the reserve water tank 750. To control the operation of the cooling means and/or refrigeration unit, a control means, for regulating temperature such as water temperature sensor or thermocouple, is provided and connected to the refrigeration unit via a control. This means would control the operation of the cooling means to assure the water therein is at a desired temperature. A similar water control means would be provided in the tank 730 to be sure the water therein is appropriately "cold," and if not, replaced by cold water from the reserve tank 750. Likewise, this control could be a thermocouple and would be used to determine if circulation of very cold water from tank 750 was needed. Similar systems are provided for the other tanks 750B and 750C, except there is no refrigeration and tank 750C has a heating element, such as a steam coil or other type heater, to make hot water.

As noted means could be used to control such circulation, say operated in response
to the thermocouples as noted. When desired, each of the tanks 750AJB and C can be drained via a line and tank drain valve(s) which connect to the main drain line.

Additionally, a recirculation supply line with its control is connected to the reserve tank 750A. This line connects to a circulating means for recirculating very cold water such as a pump for circulating very cold water from the reserve water tank 750A to fill the supply tank 730 and drum 713 back to the tank 750A.

Referring to Figure 8, a frontal view of the washer 710 of the method an apparatus of the present invention of Figures 6 and 7 is shown. In this embodiment where structure is similar to that of the earlier figures, it is given a similar reference number but uses an 800 series. For example the door 219 of Figure 2 would be 819 in Figure 8. Door 819 is attached to washer 710 by hinge 819A. Latch 819B is attached to door 819 and allows for the opening and closing mechanism of door 819. Below door 819 is a bumper 808 to prevent damage by carts typically used at a commercial laundry or cleaner to load and unload the washer. In the upper right hand corner of the front panel is bin means 794 having four rectangular compartments, 801, 802, 803 and 804. Soap may be placed in compartment 801. Bleach may be placed in compartment 802. Sour may be placed in compartment 803, and starch may be placed in compartment 804. The “dumping” of these ingredients, soap, bleach, sour, etc. are computer controlled and made at the appropriate time in the wash cycle. This embodiment has a control panel 777 on one side of the washer 710 of the method and apparatus of the present invention. This control panel provides for regulation of the water temperature and wash cycles. Situated next to control panel 777 is water level monitor 792.

Referring to Figure 9 a schematic of the water flow for an additional embodiment washer 910 is illustrated. In this embodiment where the structure is similar to that of earlier figures it is given similar reference numbers but uses a 900 series. For example, the washer drum 12 of Fig. 1 is 912 in Fig. 9. This embodiment includes 3 water tanks 950A,B and C. Each tank has a separate discharge valve at the base of the tank. 950A has valve 3, 950B has valve 2 and 950C has valve 1.

Water can be drained from the drum 912 via button trap 992 and valves 8 and 5. This embodiment of the washer mechanism includes a single pump means 987 for recirculating flow that carries out many of the features and functions of the washer during
various parts of the wash cycles. In addition to valves 1, 2 and 3, valves 6-9 and a closeable vent 10 are provided. The various valve positions and pump 987 operations for filling of the drum 912, for a wash or a rinse, or for draining the drum and during very cold water recirculation from tank 950A having the cooling coil 960 therein, is set forth in Figure 10. It should be understood that no quick fill tank is provided, and that pump 987 drains water from one of the tanks 950 A-C and discharges it directly into the drum 912 in a very quick manner. The same pump by changing setting of valves 1-9 and vent 10 can be used for recirculating very cold water from the drum 912 back to the tank 950A and then adding cooled water back into the drum. Digital drive for the pump permits the computer control (like 777) to set pump motor speed to give a desired delivery rate, high for fill and slower for recirculation.

Line 951 is connected to the city water supply and is utilized to keep in tanks 950A, B and C full. Optionally, a valve (not shown) may be used in line 951, to close that line, particularly when doing very cold water recirculation.

Referring to Figure 10 is a chart of the same of the operating conditions for the valves 1-9, vent 10 and pump 987 of this embodiment. In this operating chart "C" means "closed" and "O" means "open". The operation of the embodiment 910 is apparent from the chart in Fig. 10.

While not shown or discussed, the washers shown have the normal motor drive to rotate the basket and a control unit to operate the various valves and motor as needed for the various portions of the wash cycle. If desired, the motor may rotate the basket in either direction of rotation. It is believed that the specifics of such control operations of the valves and motor drive would be known to person's skilled in the art from the disclosure herein and particularly the flow paths shown herein. Also if desired only one or the other of the quick fill or quick drain features could be used. Likewise, the embossed or a conventional basket could be used. All this could be provided in a new washer specially constructed, or adapted to an existing washer by installing the necessary new parts, such as from an installation kit. As used herein clothes, includes all forms of clothes and the materials or cloths whether in the form of clothes or not. The equivalent of the elements and steps described above of the present invention are understood to be included herein and within the scope of the appended claims.
IMPROVED WASHER METHOD AND APPARATUS

Abstract of the Disclosure
An improved washer (10, 210, 710) having a quick fill (32, 34) and a quick drain (36, 38) with reduced overall wash time is provided. Means are provided for doing a very cold wash to permit machine washing of fine clothing that heretofore was hand washed or dry cleaned. The washer (10, 210, 710) can be provided with one (30), two (224, 230) or three tanks (750A, B & C, 950A, B & C) for water at three temperatures, very cold (refrigerated), tap or city water supply temperature, or hot water. The very cold can be made by a refrigeration or chilling means (62, 64, 98), located in or adjacent the very cold water tank. The hot water can be provided from or have a heater (230, 320, 750C, 950C) therein one of the tanks. The washer also includes an improved embossed basket (600) with increased surface area. The features can be built into a new washer or retrofitted into an existing washer. Very cold water wash and rinse can be provided so that cloths, and particularly clothes such as made of wool, rayon, acetate or other clothes, such as leathers or furs, usually dry cleaned or hand washed, can be machine washed with the present invention without use of hazardous chemicals or shrinkage.
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<th></th>
<th>VALVE 1</th>
<th>VALVE 2</th>
<th>VALVE 3</th>
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<th>VALVE 5</th>
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**FIG. 10**
FAST CLOTHES DRYER AND DRYING METHOD

This United States PCT application is a continuation of United States provisional patent applications Serial No. 60/428,424, filed November 22, 2002, entitled FAST CLOTHES DRYER and Serial No. 60/467,627, filed May 2, 2003, entitled DRYING METHOD AND APPARATUS by the same inventor for which claims of benefit of their respective filing dates and priority are made.

This invention relates to clothes dryers and clothes drying and more particularly to a method and apparatus for fast, energy efficient, clothes dryers and their use to quickly dry clothes and to a drying method and apparatus, particularly for use with drying fine clothing, which heretofore was usually dry cleaned, without shrinking.

Background of the Invention

Heretofore, it is known to have a clothes dryer utilizing hot air provided by a heat source, such as a gas burner and/or a heat exchanger, such as one utilizing steam (see U.S. Patent 4,665,628 which is incorporated herein by reference). It is also known to construct a dryer using dehumidified air to dry the clothes (see U.S. Patent Nos. 4,640,022 and 5,361,511 which are incorporated herein by reference). It is also known to discharge recovered exhaust air (see U.S. Patent 3,959,892 which is incorporated herein by reference) around the perimeter of the clothing entrance door of the dryer (see U.S. Patent Nos. 2,694,867 and 3,121,000 which are incorporated herein by reference). However, dryers of the prior art have not been capable of drying clothes quickly. Consequently, users, such as commercial laundries and dry cleaners who use dryers in their businesses, have either had to slow down their operations to accommodate the dryer's drying speed or purchase additional drying capacity. The present invention can be used with my washer disclosed in the above copending provisional application Serial No. 60/428,424, filed November 22, 2002, entitled Fast Clothes Dryer and PCT application Serial No. PCT/US03/12156, filed April 18, 2003 to very cold wash clothes heretofore dry cleaned.

Summary of the Present Invention

The present invention is a method and apparatus for drying clothes and comprises a
dryer housing, having a dryer drum, a means for providing heat to the dryer, a lint trap, a means for recovering some of the heated air after the lint trap, means for distributing the recovered air throughout the dryer, including one or more of the following: distributing recovered air through the door of the dryer, distributing recovered air to one or more positions adjacent the outer circumference of the dryer drum, and distributing recovered air into and from the fins within the dryer drum. The recovered air may be supplied by means for moving the air such as a blower, which may be blower means, such as the main blower of the dryer, or preferably by an additional or auxiliary blower. The blower is preferably driven by an electric motor. To enhance drying, the air from the means for air moving, could be first sent to a dehumidifier to remove moisture in the air and then sent to the means for distributing, i.e., a distribution manifold and associated ducting and then throughout the dryer. As to the air supplied to the door, a flexible duct connection or other means such as built in ducting can be provided to accommodate door movement. Where recovered air is supplied to the dryer drum fins, as they move and the supply duct does not, a rotary air joint can be provided in this distribution path to make the connection.

The method of the present invention includes the step of recovering heated air from the dryer after the lint trap, boosting the velocity of the recovered air, distributing the recovered air into various parts of the dryer, including the axial center of the drum, the outer circumference of the drum, and in one or more directions along the periphery of the drum, these areas being, for example, the center of the door, the center-sides of the drum, and into and through the fins on the drum. The method may also include the step of dehumidifying the recovered air before it is sent into various parts of the dryer.

Use of the dryer with the foregoing features is believed to cut dryer time by at least 20 to 50%. Even with just the use of the through-the-door air delivery system, drying time has been reduced from 20 minutes drying time to just 15 minutes drying time (a 25% reduction). Not only is drying time reduced, the energy supplied as heat is also reduced generally in proportion to the reduced drying time. Further, the additional air flow greatly supplements the tumble action of the dryer drum’s rotation and results in less wrinkling in the clothes as they come from the dryer. This results in further time and energy savings as less work and time is needed to subsequently press or iron clothes dried in the dryer and method of the present invention.

The invention includes a further embodiment of drying apparatus and a method for
operating the same. The apparatus includes the use of recirculating air which may be cooled and/or dehumidified to prevent shrinkage of clothing. In this embodiment, the recirculated air is discharged back into the dryer drum through a large say 2” x 4” rectangular duct situated near the dryer W door’s periphery, but on the dryer cabinet, rather than in the door.

In the method, the cloth or clothes go through a simulated "hung drying" or "blocking drying" portion of the cycle. That is, they are dried in a manner similar to hanging from a line 4 with little or no mechanical action (tumbling), to prevent shrinkage by at least for a period rotating the dryer drum with sufficient speed to hold the clothes pinned against the drum. This dries one side of the clothes. Then the drum is momentarily halted so the clothes fell and reorient themselves and the dryer drum rotation is reversed, again maintaining speed to keep the clothes pinned to the drum. These two steps may be repeated several times say for a duration of 15 to 25 minutes, with say 4 direction reversals and about four 5-minute drying cycles being preferred. Thus, both sides are dried essentially without tumbling. The elimination of tumbling at this initial drying stage will prevent shrinkage heretofore seen due to mechanical tumbling action. At this stage, the air may be quite warm say from 100° to 135° with about 120° being preferred. The tolerance in the temperatures may be about plus or minus 5°F. The air used is dehumidified to remove the moisture and then recirculated back into the drum, or could be taken from the environment and exhausted to the environment, but the former is preferred.

For example, with a dryer drum of about 3 feet, in the drum speed might be 50 to 90 RPM with about 75 RPM being preferred for this initial "hang drying" phase. To achieve this speed, the dryer drum drive can provide different speeds, such as by "chopping" the electric current to the motor. The above speeds are say plus or minus 10 RPM with this drum diameter. The drum diameter and speed being chosen during the "hang drying" phase to keep the clothes held on the drum and avoid tumbling. Of course, the drum speed and diameter are selected or designed to achieve the desired effect. The motor drive alone is of course capable of variable speed, such as by motor drive selection, or less desirable due to higher costs, the use of a transmission say of the variable speed or other type.

Next in what is called the "gentle" portion of the cycle, the dryer drum is greatly slowed down to a drum speed that very gently tumbles the clothes. During the gentle cycle the drum is rotated one direction at slow speed, say 20 to 15 RPM For a 3 foot diameter drum, with about 17 to 18 RPM being preferred, for a short time, say 15 to 30 seconds,
then stopped and the direction of rotation of the drum reversed and again stopped. These "gentle" cycle motions are repeated for say 10 to 20 minutes with about 15 minutes being preferred. Again, these times have tolerances say plus or minus 3 seconds for time measured in seconds and plus or minus 3 minutes for time measured in minutes. In the "gentle" cycle, heated air is not used, and instead cold air is used say on the order of 50°F, again say plus or minus 15°F, with 50°F being preferred. The use of cold air when the gentle tumbling takes place greatly minimizes any tending of the clothes to shrink. Again, the air is cooled and dehumidified and recycled back to the dryer drum in the gentle portion of the cycle.

After about 15 minutes of gentle cycle, the clothes are nearly dry and less susceptible to shrinking.

After the gentle portion of the drying cycle, the clothes can be normally dried, say again with about 120°F air, with optionally the dehumidification of the recycled air being continued for about 15 minutes and/or until dry. During this phase, the drum speed can be increased say to about 35 RPM to provide normal tumbling. Again the speed could be plus or minus 10 RPM.

The advantage of the system of the present invention is that the clothes can be "dry cleaned" in my above described washer method and apparatus and then dried in my above described dryer method and apparatus and herein within about one hour without any shrinkage or worries about customer complaints.

**Brief Description of the Drawings**

Figure 1 is a schematic front elevation view of a clothes dryer incorporating and for use in practicing the present invention.

Figure 2 is a schematic view similar to Figure 1, but with a portion of the front wall broken away to illustrate the motor, blower, dehumidifier and recovered air distribution manifold therein and with portions of the recovered air distribution manifold ducts shown in dashed lines.

Figure 2A is a schematic view of an alternative arrangement showing the dehumidifier mounted between the blower and portions of the recovered air distribution manifold.

Figure 3 is a schematic top view of the dryer shown in Figure 1, with the screen of
the dryer drum only partially shown and the blower, motor and recovered air distribution manifold shown in phantom.

Figure 4 is a schematic top view taken below the top of the dryer housing and illustrates a cross-section of the dryer drum showing how air is provided to and discharged from the dryer, drum fins, blower, dehumidifier, motor, recovered air distribution manifold and ducting.

Figure 5 is a schematic front elevational view, similar to Figure 1, but taken behind the front panel of the dryer, to show the drum, blower, motor, optional dehumidifier air distribution manifold and ducting.

Figure 6 is an enlarged schematic perspective view of the dryer drum showing the dryer screen perimeter and dryer drum air distributing fins.

Figure 7 is an enlarged schematic axial cross-sectional view of the dryer drum showing how air is supplied to the air distributing fins, via rotary air joint 78 and its associated duct 44.

Figure 8 is a view similar to Figure 7 using arrowheads to illustrate drying air flow.

Figure 9 is a view similar to Figure 1 using arrowheads to illustrate drying air flow.

Figure 10 is a view similar to Figure 3 using arrowheads to illustrate drying air flow.

Figure 11 is Graph I of water weight vs. drying time showing how the present invention speeds up drying and reduces drying time.

Figure 12 is Graphic II of water weight vs. drying time.

Figures 13 and 14 are a comparison showing how the present invention also reduces wrinkling even with the shorter drying time; Figure 13 showing a piece of clothing with wrinkles produced in a conventional dryer, and Figure 14 showing reduced wrinkling when the same dryer of the present invention is used.

Figure 15 is a block diagram illustrating the air flow path through the dryer of the present invention.

Figure 16 is a schematic of the drying cycle of temperature v. time.

Figure 17 is a schematic of the further embodiment of the dryer of the invention

**Description of the Preferred Embodiments**

Referring now to the drawings in greater detail, there is illustrated therein a dryer
made in accordance with the teachings of the present invention and generally identified by the reference numeral 10.

The dryer includes a housing 11 within which a door 12 is provided through which items, for example, clothes, are inserted for drying and removed thereafter. Typically such door includes a handle 14 which may or may not include a lock. The door is also typically mounted in a front door panel 15 of the housing 11.

The dryer 10 also typically includes a lint door 16 having a handle 18 thereon, a lint trap 19 in the form of a cloth or mesh sack or sock of the dryer 10 being situated behind the lint door 16.

In the dryer 10 illustrated, an opening 20 is provided in or adjacent the door 12, within and to which one end 21 of a door air duct 22 is engaged. The door air duct 22 is engaged via a flexible connection 24 such as flexible hose. The flexible duct for the door duct could be of the bellows type and made of rubber or plastic. The duct connection 24 is flexible to allow for opening and closing of the door 12.

Positioned within the housing 11, behind the clothes door 12 is a dryer drum 26 which incorporates radial fins 28 on an inner surface 29 thereof the cylindrical surface of the drum being formed by a metal open mesh or screen. Thus, as the dryer drum 26 rotates, the fins 28 assist in producing, when desired, tumbling of clothes therein, for the drying of same.

A heater 31 of any suitable type is provided in the dryer 10 for heating air moved through the drum 26 by the main blower, and if provided, a motor 30 of an auxiliary blower 32. Heated recovered air enters the blower 32 through an inlet 34 thereto, a suitable heater being, for example, a gas burner or of the hot water or steam heated heat exchanger.

The motor 30 drives the blower 32 to draw air from the dryer after the air passes through the lint trap. From the blower 32 the air is directed into a distribution manifold 36 which sends air to various areas of the drum 26 via a plurality of ducts, such as, for example, a door duct 38, a right side duct 40, a left side duct 42, a rear duct 44, or any combination suitable for the purpose of drying clothes within the drum 26. Alternatively, it will be understood that the blower 32 could be powered by the dryer main motor, rather than by the auxiliary blower motor 30.

The recovered air duct diameters are for example, two to six inches, with about three inches being preferred. Also, if desired, a dehumidifier 50 may be incorporated into the recovered air path to remove moisture from the recovered air provided to the drum 26.
The blower motor 30 in this embodiment is made by Dayton under model No. 2C946B, and provides airflow at 320 cubic feet per minute. Any blower providing airflow from 200 to 1000 cubic feet per minute could be used. The motor 30 for the blower 22 is rated at 1/6 horsepower. The drum 26 in the preferred embodiment is made of a screen mesh material and includes a double wall 46 on a rear end 48 thereof, comprising an outer rear wall 64 and an inner rear wall 66 defining an air chamber 67 therebetween, the air chamber 67 feeding air into, through and out of the fins 28 of the drum 26 as will be described in greater detail below.

The drum fins 28 are generally each triangular in cross section and include a closed forward end 68, together with a closed outer wall 70 which is adjacent the drum 26. A rear end 71 of each fin is open and is connected to and forms a continuation of the air chamber 67 at the rear end 48 of the drum 26. Each fin also comprises two inner walls 72 which converge toward one another as they generally radially extend into the drum 26. Each inner wall 72 incorporates a plurality of air ports or outlets 74 therein, through which air from the chamber 76 is released into the drum 26. The fin openings are of 1/8 to 1/2 inches with 1/4 inches preferred. These air ports can be provided on both sides of each fin and spaced several inches apart.

Inasmuch as the drum 26 is rotating as drying of articles therein proceeds and the air supply feeding the air chamber 67 is stationary, a rotary joint 78 such as that manufactured by SKP is interposed therebetween. The rotary joint is sufficient size to feed air through the dryer drum shaft to the fins. If need be, the dryer drum shaft can be sized to have an air path therethrough to give an acceptable air flow quantity.

As the articles in the dryer drum 26 come into contact with the fins 28, in known manner, to aid in tumbling of the articles within the dryer 10, air exiting the air ports 74 further assists in drying of articles and in moving the articles out of contact with the fins 28. The added air flow in the dryer not only enhances drying, it minimizes wrinkling (see Figures 13 and 14).

Turning now to Figures 11 and 12 there is shown in each graphic illustration of results of empirical testing how the dryer 10 of the present invention (with just door recovered air flow) is of greater effectivity than a conventional dryer (50 lbs. clothes weight, made by Speed Queen), showing that water weight of articles dried in the dryer 10 decreases far more quickly, and consequently the articles dried more quickly as well.
Further, referring to wrinkling of articles being dried, it has been found that wrinkling is significantly decreased by the dryer 10 of the present invention as shown in Figure 14, as compared to wrinkling produced by a conventional dryer, as shown in Figure 13.

Shown in Figure 15 is a block schematic diagram of the structures comprising the dryer 10, and showing air flow and recovered air flow therethrough more clearly.

Also, although in a preferred embodiment recirculated air may be reheated by the heater 31 and fed back into the drum 26, it will be understood that this is optional.

Still further, it will be understood that motor(s) and blower(s) of the dryer 10 generate heat and that such added heat will be used in the dryer 10 to help dry the clothes.

Also, the moist air from the clothes being dried in the dryer 10 will be used to help cooling of such motor(s) and blower(s).

Also, it will be understood that a retrofit of conventional dryers is possible through conversion of the conventional dryer (such as that abovementioned Speed Queen) to incorporate a substantially similar airflow path through the dryer, as exemplified herein.

A kit comprising items such as a door and door vent with appurtenant required structures, hoses, a motor and auxiliary blower (if needed) and possibly even a mesh screen drum could be provided. Thus, retrofitting a conventional dryer is within the scope of the invention.

In Figure 16, the plot of drying temperature versus time is shown in phase I, the simulated "hang drying" time is around 120°F. Then in phase II, the "gentle cycle" with very light mechanical tumbling, the temperature is brought down to about 50°F. Then in the normal drying time the temperature may be brought back up to about 120°F. The dryer drum speeds are high (about 75 RPM) in phase I, low (about 17-18 RPM) in phase II and medium (about 35 RPM) in phase III, with the dot 110 representing completed drying.

Referring to Figure 17, the dryer is indicated at 120 and has a cabinet 124 including side walls 124a, 124b, 124c and 124d. Inside the cabinet 124 is the dryer drum 128 which can be rotated at high, medium or slow speeds respectively by a variable speed motor or transmission, indicated at 130. The drum has an open end 134 which in conjunction with the cabinet is closed by a door 136. Adjacent the door 136 is the recirculating dryer air duct exit 140 into the interior of the dryer drum wherein the_clothes are placed.

As can be seen, this air flows form a duct 146 having situated therein a cooling coil
or heat exchange for providing cool air and dehumidification, indicated at "C", and a heating coil or exchanger such as using steam to heat the recirculating air; and indicated by H. As shown, the refrigeration or cooling means for providing the cool air or dehumidification is provided at 150 and connected to the heat exchange C by lines 151 and 152.

As can be seen, recirculated air can be supplied to the drum then pulled into the lint trap 164 below by a blower 170 and blower motor 172. Then the blower 170 with motor 172 sends the air through H and/or C or both to be returned via duct 146 to the dryer drum 128.

While several embodiments have been described, it should be understood that the apparatus and method of the present invention include equivalent structures and steps of those described in the accompanying claims.
A fast clothes dryer (10) is provided and has a blower (32) located after the dryer lint trap (19) to recover air, boost its velocity and then distribute it throughout the dryer, includes the dryer door (12), dryer fins (28) and dryer circumference. If additional drying is desired, the recovered air can be dehumidified before it is distributed throughout the dryer (10). The inclusion of just one of these features, the air flow through the dryer door (12) can cut drying time from say 20 minutes to 15 minutes, with less wrinkling. The dryer and method use cold air to dry clothes without shrinkage, and to avoid tumbling at initial stages of drying. The clothes may be initially dried at a warm temperature and at a speed high enough to prevent mechanical tumbling for a first period (say 20 minutes) using rotation first in one then the other direction. Then, when partially dry, cold dehumidified air is used with a lower drum rotation speed to permit very gentle tumbling with the drum rotation varying in directions for a second period of say 15 minutes. Thereafter, the clothes may be normally dried at a normal temperature and medium drum speed until done, say for another 10 to 15 minutes.
FIG. 8
FIG. 15
What Is Claimed Is:

1. An improved washer comprising means for holding clothes in place during washing, means for sending water and soap through the clothes held in place during washing to wash the same, means for rinsing the clothes held in place, and means for drying the clothes at least initially while held in place, whereby the clothes can be washed with minimized shrinkage.

2. An improved washer as in Claim 1, wherein said means for holding the clothes in place during washing includes a basket rotated at a speed to hold the clothes to the basket by centrifugal force.

3. An improved washer as in Claim 1, wherein said means for sending water and soap through the clothes held in place comprises a sprayer for spraying water and soap onto the clothes held in place.

4. An improved washer as in Claim 2, wherein said means for holding the clothes in place during washing includes a basket rotated at a speed to hold the clothes to the basket by centrifugal force.

5. An improved washer as in Claim 1, wherein said means for sending water and soap is supplied with cold water for washing.

6. An improved washer as in Claim 5, wherein said means for sending water and soap through the clothes held in place is also the means for rinsing the clothes held in place.

7. An improved washer as in Claim 1, wherein said means for sending water and soap through the clothes held in place is also the means for rinsing the clothes held in place.

8. An improved washer as in Claim 7, wherein water for washing and for rinsing is in cold water.

9. An improved washer as in Claim 8, wherein the cold water is 45° F or colder.

10. An improved washer as in Claim 5, wherein the cold water is 45° F or colder.

11. An improved washer as in Claim 1, wherein the clothes are first distributed around the means for holding the clothes in place.

12. An improved washer as in Claim 2, further including means for rotating the basket at high speed to permit the clothes to be held in place and at a slower speed to prevent the clothes being held in place to distribute about the basket.

13. An improved washer as in Claim 2, further including means for rotating the basket in one direction and then the other direction.
14. An improved washer as in Claim 1, further including means for providing the drying means with cold air for the initial drying.

15. An improved washer as in Claim 14, wherein said cold air is 65°F or less.

16. An improved washer as in Claim 1, also providing conventional wash cycles.

17. An improved washer as in Claim 1, also providing conventional drying cycles.

18. An improved washer as in Claim 1, wherein said washer can be a conventional washer and comprises a kit to convert the conventional washer to the improved washer.

19. An improved washer as in Claim 2, wherein said means for sending water and soap through the clothes held in place comprises a sprayer for spraying water and soap onto the clothes held in place, further including means for rotating the basket at high speed to permit the clothes to be held in place and at a slower speed to prevent the clothes being held in place to distribute about the basket, further including means for rotating the basket in one direction and then the other direction.

20. An improved washer as in Claim 19, wherein the clothes are first distributed around the means for holding the clothes in place, further including means for rotating the basket at high speed to permit the clothes to be held in place and at a slower speed to prevent the clothes being held in place to distribute about the basket, further including means for rotating the basket in one direction and then the other direction.

21. An improved washer as in Claim 19, further including means for providing the drying means with cold air for the initial drying, wherein said cold air is 65°F or less.

22. An improved method for washing clothes which were previously usually dry cleaned, comprising holding the clothes in place, providing cold wash water for washing the clothes held in place providing soap for washing the clothes held in place, moving the cold water and soap through the clothes held in place during washing, supplying cold water to rinse the clothes held in place rinsing the clothes held in place with the cold water, providing cold air to the clothes held in place, at least initially drying the clothes held in place with the cold air, whereby the clothes may be washed and dried while minimizing shrinkage of the clothes usually previously dry cleaned.
23. An improved method as in Claim 22, wherein the step of holding the clothes in place comprising providing a basket and spinning the basket at a speed high enough to hold the clothes in place.

24. An improved method as in Claim 22, wherein the step of providing cold water is providing water of 45°F or colder, and the step of providing cold air is providing air of 65°F or colder.

25. The improved method of Claim 23, wherein the step of providing cold water comprising providing water of 45°F or colder, and the step of providing cold air comprising providing air of 65°F or colder the step of spinning the basket includes the step of spinning the basket fast enough to hold the clothes in place during washing, rinsing and drying and the step of spinning the basket at a slower speed during drying to permit tumbling and initially and as needed for distributing the clothes about the basket, and rotating the basket in one direction and the other direction for at least one of distributing the clothing and drying the clothing.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

PCT/US 07/23 4 2 4

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

USPC - 8/158

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

USPC - 68/3R, 68/208, 68/207 - see keywords below; Google Patent Internet - see keywords below

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

GOOGLE PATENTS, GOOGLE WEB, GOOGLE SCHOLAR and WEST (PGPB, USPT, EPAB, JPAB): washing, washing machine, washer, cold water, cold air, shrinkage, clothing, centrifugal, basket, soap, detergent, rinsing, drying, dryer, dry cleaning, low temperature, air fluff cycle, laundry

**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 5,191,668 A (Euler et al.) 09 March 1993 (09.03.1993), col. 2, In 14-23; col. 3, In 15-33; col. 4, In 30-44; col. 5, In 48-62; col. 6, In 41-64; col. 7, In 16-39; col. 8, In 56 - col. 9, In 9; col. 9, In 10-27</td>
<td>1-25</td>
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<td>US 2005/0050644 A1 (Severns et al.) 10 March 2005 (10.03.2005), para [0008]; para [0079]; para [0111]; para [0136]; para [0143]; para [0146]; para [0148]; para [0149]; para [0150]; para [0187].</td>
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<td>US 2,983,129 A (Metzger) 09 May 1961 (09.05.1961), col. 10, In 73 - col. 11, In 17.</td>
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</tbody>
</table>

**D** Further documents are listed in the continuation of Box C □

| "A" | Special categories of cited documents |
| "E" | earlier application or patent but published on or after the international filing date |
| "L" | document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) |
| "O" | document referring to an oral disclosure, use, exhibition or other means |
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| "T" | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
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| "Y" | document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| "&" | document member of the same patent family |

Date of the actual completion of the international search: 03 June 2008 (03.06.2008)

Date of mailing of the international search report: 25 JUN 2008

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