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(54) **WASHER EXTRACTOR APPARATUS AND METHOD**

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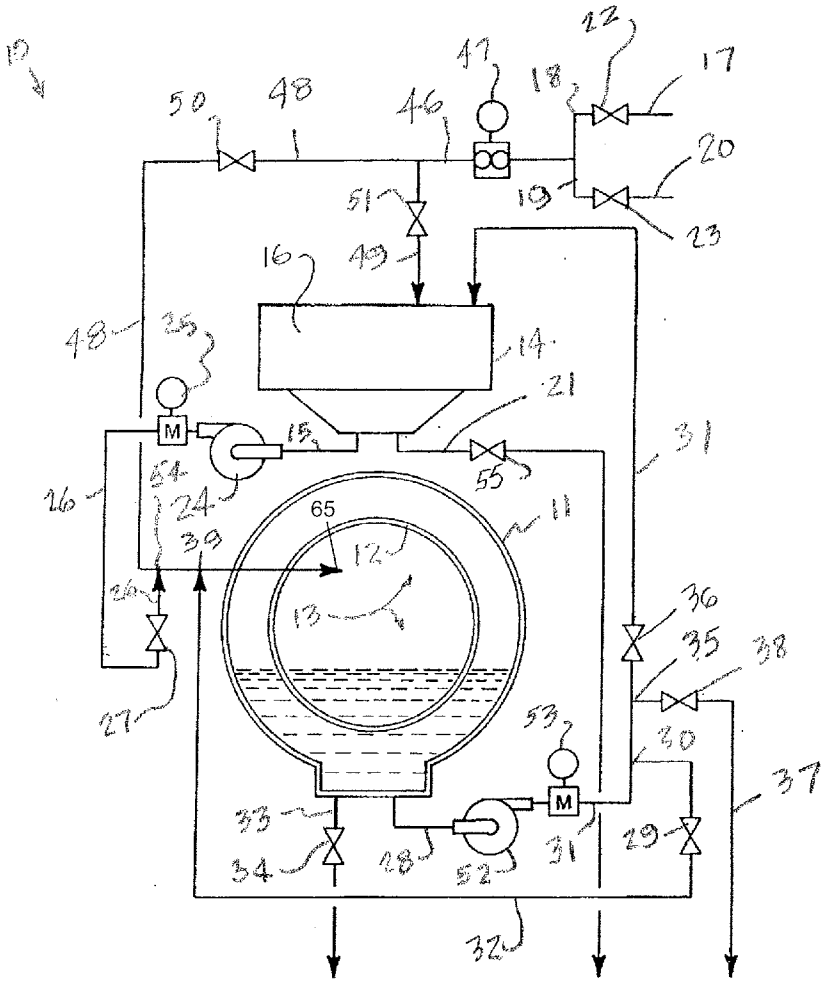
USPC **8/137**; 68/12.21

(57) **ABSTRACT**

A method of washing fabric articles provides a washer extractor having a reservoir for holding fabric articles and a washing liquid. A washing liquid is pumped from the reservoir to the washer extractor interior. The ratio of pounds (or kilograms) of washing liquid to pounds (or kilograms) of fabric articles is about 4 to 1, plus absorbed water. Fluid is pulse flowed to the textile articles at a volume of between about 0.5 to 2 gallons (2 to 8 liters) per pound (kg) of fabric articles for a selected time interval. Washing chemicals are added to the washer extractor. Water is transmitted to the washer extractor at the rate of 0.35 to 0.6 gallons (1.33 to 2.3 liters) of water per pound (kg) of fabric articles within a selected time interval.



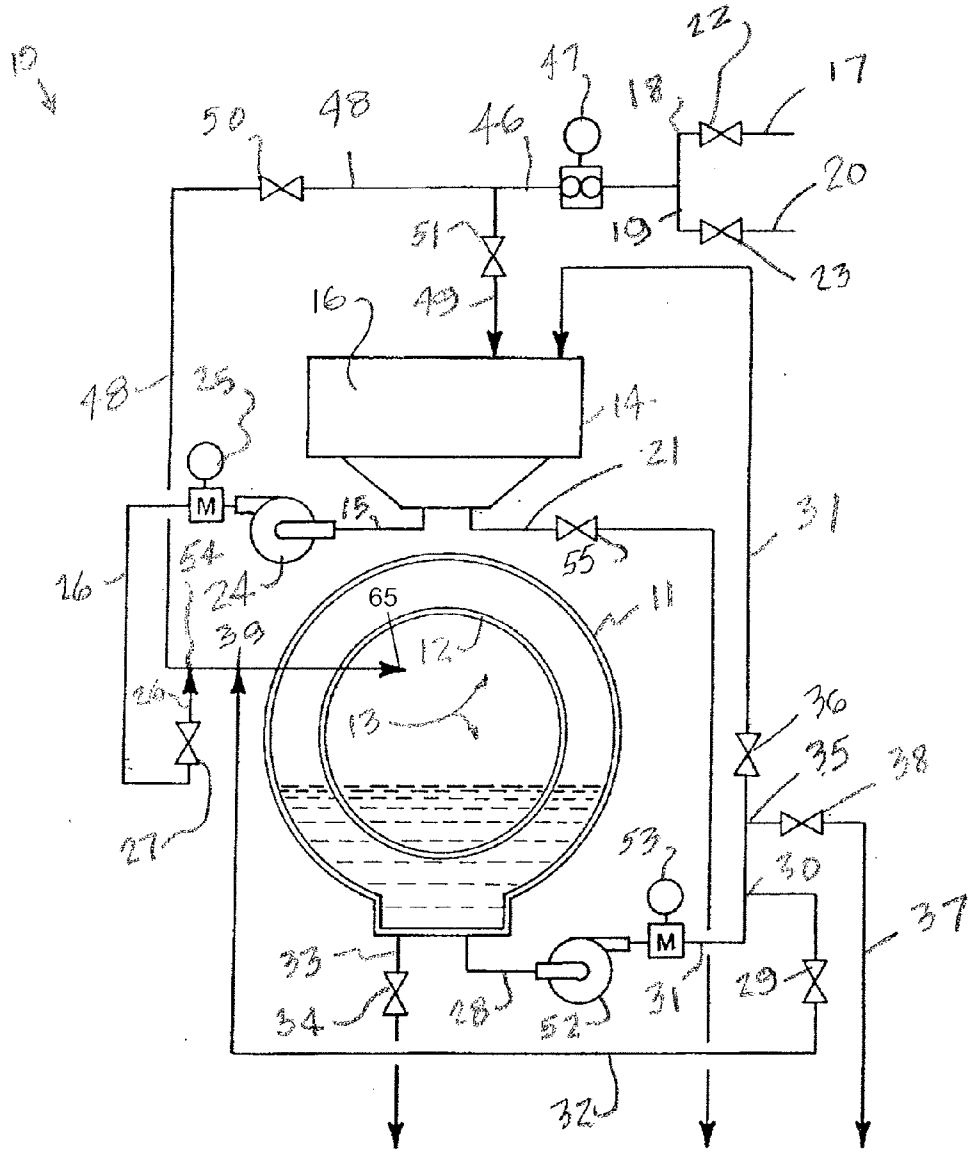

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FIG. 1.

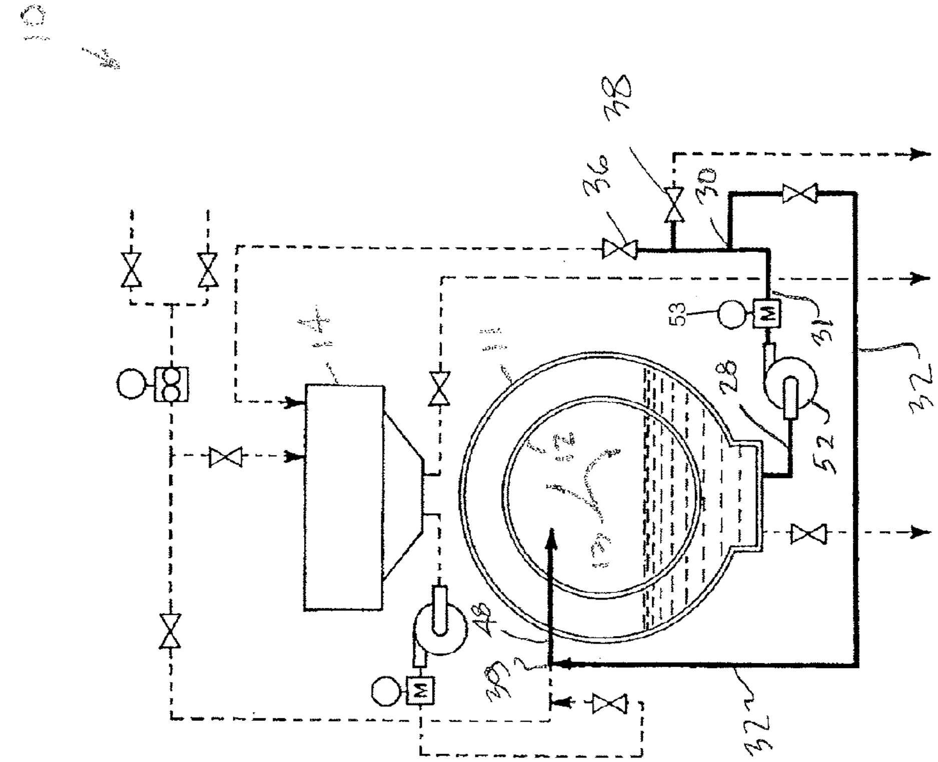
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FIG. 3.

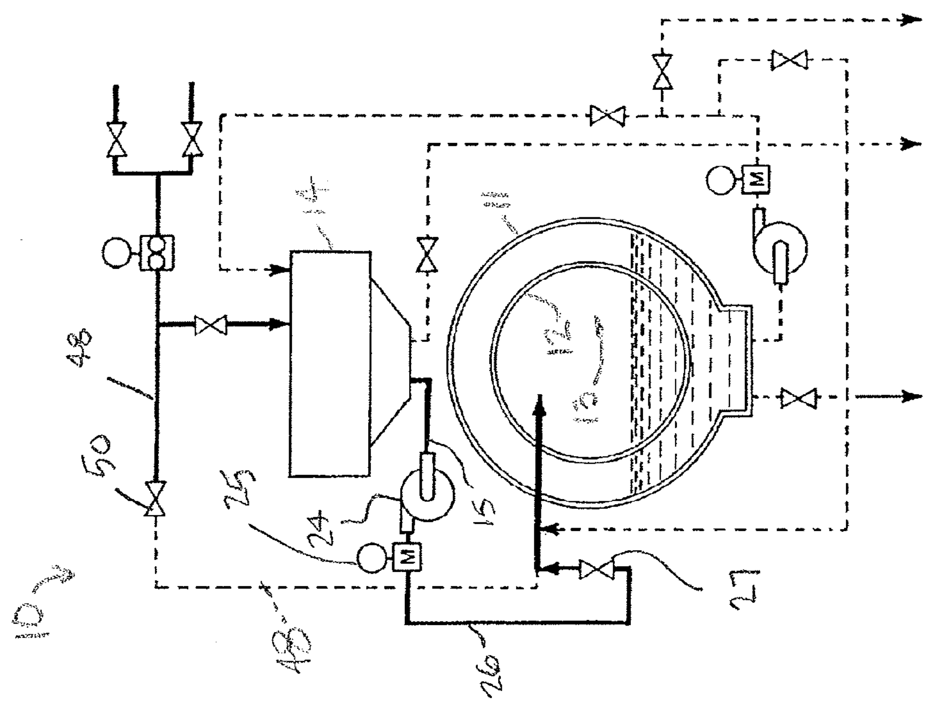
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FIG. 2.

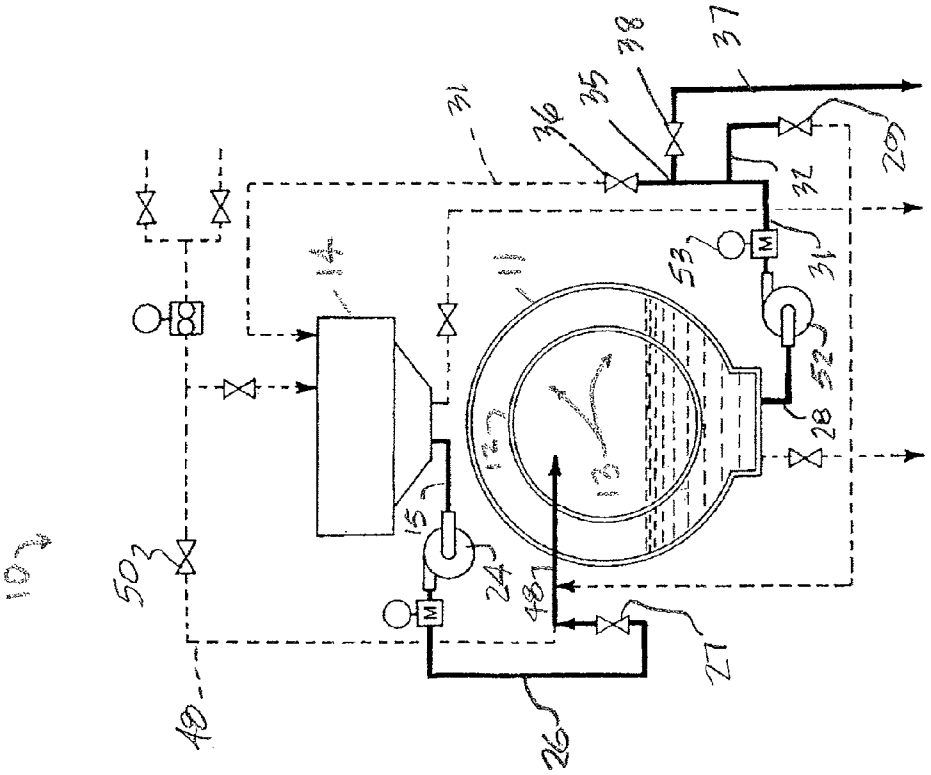
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FIG. 5.

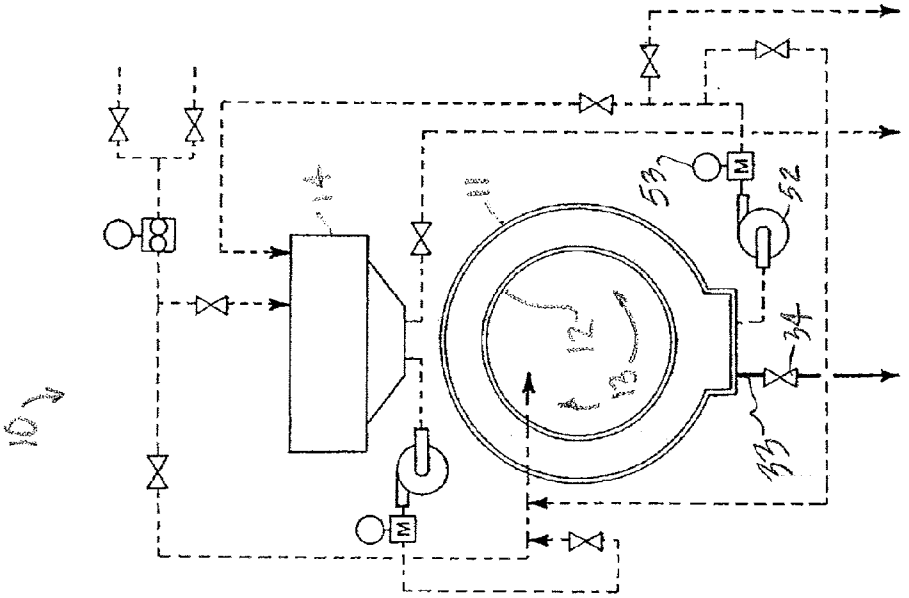
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FIG. 4.

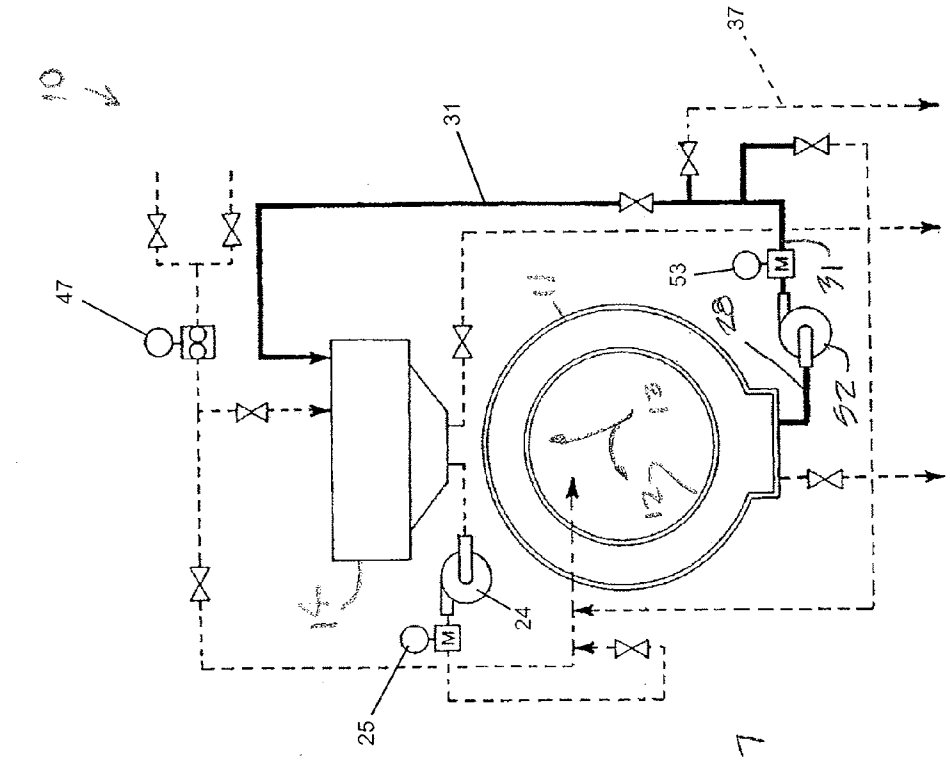
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FIG.7.

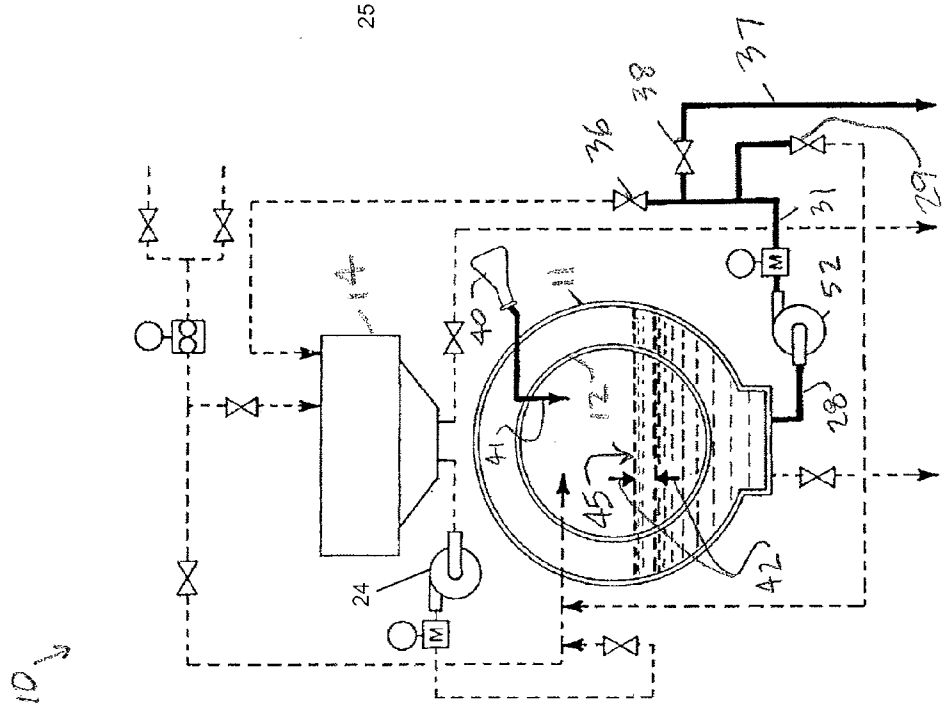
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FIG.6.

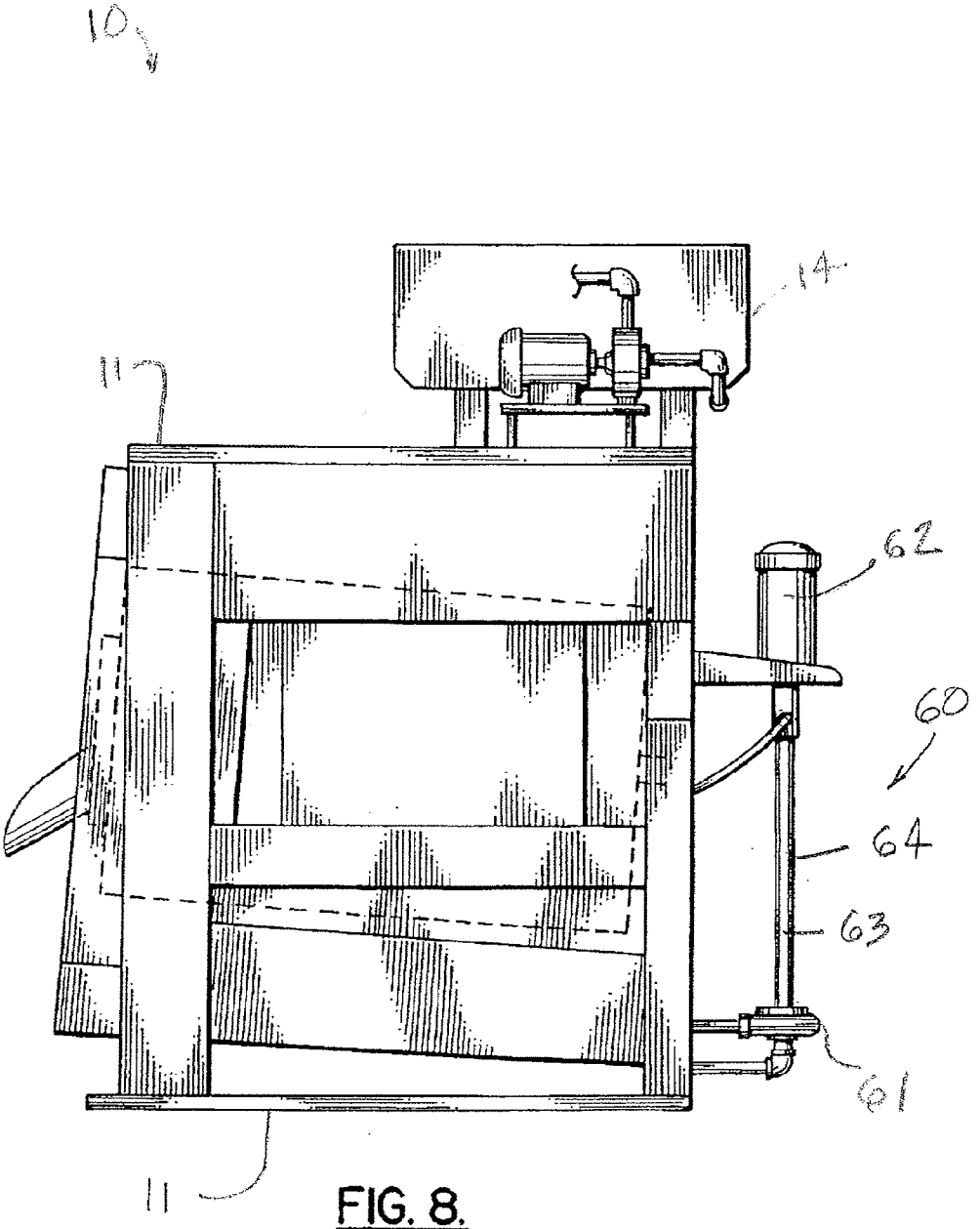

FIG. 8.

WASHER EXTRACTOR APPARATUS AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a nonprovisional patent application of U.S. Provisional Patent Application Ser. No. 61/691,532, filed 21 Aug. 2012, which is hereby incorporated herein by reference.

[0002] Priority of U.S. Provisional Patent Application Ser. No. 61/691,532, filed 21 Aug. 2012, incorporated herein by reference, is hereby claimed.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0003] Not applicable

REFERENCE TO A "MICROFICHE APPENDIX"

[0004] Not applicable

BACKGROUND OF THE INVENTION

[0005] 1. Field of the Invention

[0006] The present invention relates to washer extractors, more particularly to an improved washer extractor that uses overflow rinsing to eliminate most or all of the fill and drain steps typically associated with prior art washer extractors. Even more particularly, the present invention relates to an improved washer extractor wherein the liquor ratio (pounds or kilograms water or liquor to pounds or kilograms of fabric articles) can be varied to suit different levels of soiled linen or other fabric articles.

[0007] 2. General Background of the Invention

[0008] Prior art washer extractor machines wash and rinse fabric articles such as linen with successive fill and drain steps. A typical wash formula comprises between 6 and 20 steps, depending on linen soil classification.

[0009] Because each step drains the wash/rinse liquor, water consumption is generally between two (2) and four (4) gallons (16 and 33 liters) per pound (kg) ofprocessed linen. In prior art washer extractors, all of the liquid is drained to sewer or to recycling/filtering systems.

BRIEF SUMMARY OF THE INVENTION

[0010] The design of the present invention provides an improved washer extractor. The present invention uses high velocity overflow rinsing to eliminate many, if not all, fill and drain steps. The high velocity of the water increases the hydraulic pressure on the soil in the linen and suspended in the wash liquor, thus reducing the amount of rinse water required.

[0011] Typical water consumption with this system is between about one-half (½) and two (2) gallons (4-16 liters) per pound (kg) of processed linen.

[0012] The present invention provides a method and apparatus for achieving a desired overflow rinsing while flowing liquid into the fabric articles at a high rate. The method of the present invention provides a variable level arrangement that enables variable programmable liquor ratios which are useful when processing different levels of soiled linen.

[0013] Normally, the liquor ratio (pounds or kilograms water or liquor to pounds or kilograms of fabric articles) is about 4:1 during the standing bath portion of a washer extractor cycle.

[0014] During rinsing, a high volume of water or other fluid is thrust into the drum of the washer extractor. As part of the method of the present invention, pumps are used to vary the level of water contained within the drum. The level of water in the drum thus rises to achieve a liquor ratio that is higher than the usual 4:1 ratio used during a standing bath portion of the cycle. Liquor ratio can be defined as the ratio of the pounds (or kilograms) of water to the pounds (or kilograms) of fabric articles being washed. This fluid level rise and higher liquor ratio preferably produces a liquor ratio of between about 5:1 and 10:1 or higher.

[0015] A level sensor can be used to determine the water level within the drum of the washer extractor. The level sensor can determine if the water level is high enough to reach a preprogrammed ratio such as between about 5:1 and 10:1 for the liquor ratio. At that time, a pump turns on. The flow rate of the pump can be varied (for example, using a frequency inverter) to maintain the desired preprogrammed liquor ratio. An advantage of the method of the present invention is that it easily provides the user with variable programmable liquor ratios which is useful when processing different levels of soiled linen.

[0016] The present invention provides a method of washing fabric articles. The method includes providing a reservoir of washing liquid and a washer extractor having an interior for holding fabric articles.

[0017] The fabric articles to be washed are placed in the interior of the washer extractor.

[0018] The washing liquid is pumped from the reservoir to the washer extractor interior.

[0019] Washing chemicals are added to the washer extractor interior.

[0020] Rinse water is transmitted to the washer extractor interior within a selected time interval.

[0021] As part of the method, the liquor ratio increases. This increase can be to a value of between 5:1 and 10:1.

[0022] Liquid is then extracted from the washer extractor.

[0023] In one embodiment, a chemical such as alkali can be added to the wash.

[0024] In one embodiment, one of the added chemicals is a detergent.

[0025] In one embodiment, one of the added chemicals is a sour solution.

[0026] In one embodiment, water consumption is between about ½ and 2 gallons (4-16 liters) per pound (kg) of processed fabric articles.

[0027] In one embodiment, the water temperature is in excess of 100 degrees F. (38 degrees C.).

[0028] In one embodiment, the water temperature is in excess of 120 degrees F. (49 degrees C.).

[0029] In one embodiment, the time interval is about one minute.

[0030] In one embodiment, the time interval is about four minutes.

[0031] In one embodiment, the ratio of pounds or kilograms of washing liquid to pounds or kilograms of fabric articles is about 4 to 1, plus absorbed water.

[0032] The present invention includes a method of washing fabric articles, comprising the steps of providing a reservoir of washing liquid, providing a washer extractor having an interior for holding fabric articles, placing fabric articles to be washed in the interior of the washer extractor, pumping the washing liquid from the reservoir to the washer extractor interior with a first pump, adding washing chemicals to the

washer extractor interior while it is filled with washing liquid and fabric articles, transmitting rinse water to the washing extractor interior within a selected time interval with said first pump, and withdrawing the rinse water from the washer extractor interior with a second pump.

[0033] The present invention includes a washer extractor apparatus, comprising a washer extractor for holding fabric articles to be washed in a volume of a washing liquid having an associated reservoir and a washer drum with an extractor interior. A reservoir having a flow line enables transmission of washing liquid from the reservoir to the washer extractor interior. A first pump at a first elevation enables flowing of rinse fluid to the combination of fabric articles and washing liquid at a rate of between about 30 to 700 gallons (114 to 2,650 liters) per minute for a selected time interval. A second pump at a second elevation lower than said first elevation enables extraction of excess liquid from the washer extractor in order to maintain a selected volume of liquid in said interior. A controller enables a change in the volume of fluid being pumped by the second pump to a flow value that is different from the volume of fluid pumped by the first pump so that the fluid level in the drum can be changed to a new and different liquor ratio.

[0034] The present invention includes a method of washing fabric articles, comprising the steps of providing a reservoir of liquid, providing a washer extractor having an interior for holding fabric articles, placing fabric articles to be washed in the interior of the washer extractor, pumping the liquid from the reservoir to the washer extractor interior with a first pump, wherein the washer extractor interior has a liquid upper surface, adding washing chemicals to the washer extractor interior, transmitting rinse water to the washing extractor interior at a rate of between about thirty and seven hundred gallons (114 to 2,650 liters) per minute, and extracting liquid from the washer extractor, wherein excess liquid that has been added is discharged via an effluent flow line.

[0035] In one embodiment, at least some of the withdrawn liquid is re-circulated to the reservoir.

[0036] In one embodiment, the present invention further comprises a re-circulation flow line connecting the washer extractor to the reservoir, wherein said re-circulation flow line enables transmission of at least some of the extracted liquid to the reservoir and wherein the said second pump is in said re-circulation flow line.

[0037] In one embodiment, at least some of the extracted liquid is re-circulated to comprise at least a part of the rinse water.

[0038] In one embodiment, the present invention further comprises a re-circulation flow line that conveys all or part of said excess liquid to said reservoir.

[0039] In one embodiment, the present invention further comprises placing the second pump below the first pump.

[0040] In one embodiment, the present invention further comprises placing the washer extractor interior below the first pump.

[0041] In one embodiment, the second pump is a column pump.

[0042] In one embodiment, the second pump is below the washer drum.

[0043] In one embodiment, the present invention further comprises placing a second pump below the first pump.

[0044] In one embodiment, the reservoir is refilled with rinse water.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0045] For a further understanding of the nature, objects, and advantages of the present invention, reference should be had to the following detailed description, read in conjunction with the following drawings, wherein like reference numerals denote like elements and wherein:

[0046] FIG. **1** is a schematic diagram of a preferred embodiment of the apparatus of the present invention;

[0047] FIG. **2** is a schematic diagram of a preferred embodiment of the apparatus of the present invention showing an initial filling step;

[0048] FIG. **3** is a schematic diagram of a preferred embodiment of the apparatus of the present invention showing the recirculation step;

[0049] FIG. **4** is a schematic diagram of a preferred embodiment of the apparatus of the present invention showing the intermediate extract step;

[0050] FIG. **5** is a schematic diagram of a preferred embodiment of the apparatus of the present invention showing the rinsing step;

[0051] FIG. **6** is a schematic diagram of a preferred embodiment of the apparatus of the present invention showing the finishing step;

[0052] FIG. **7** is a schematic diagram of a preferred embodiment of the apparatus of the present invention showing final extract; and

[0053] FIG. **8** is an elevation view of a preferred embodiment of the apparatus of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0054] FIGS. **1-8** show a preferred embodiment of the apparatus of the present invention, designated generally by the numeral **10**. Washer extractor apparatus **10** provides a machine **11** which can be in the form of a drum, extractor, or any other machine capable of washing textiles such as linens followed by an extraction of water from those textile articles.

[0055] Machine **11** provides a drum **12** interior **13** for holding fabric articles (e.g., linen articles) to be washed and rinsed. Tank or sump **14** can be used to mix fresh cold water via line **17** and fresh hot water via line **20**. The mixture of hot/cold water in tank **14** can be pumped to drum **12** interior **13** via flow line **15**. Tank **14** provides tank interior **16** where hot and cold source water is mixed to provide fresh water having a selected temperature.

[0056] In FIGS. **1-7**, there is a fresh cold water source **17** and a fresh hot water source **20**. Flow line **18** enables fresh cold water to be added to tank or sump **14** interior **16**. Flow line **19** enables fresh hot water to be added to tank or sump **14** interior **16**. Each flow line **18**, **19** can be provided with a valve. Flow line **18** has valve **22**. Flow line **19** has valve **23**. The flow lines **18**, **19** feed flow line **46** which splits to flow lines **48**, **49**. Flow line **48** has valve **50**. Flow line **49** has valve **51**. Flow line **46** has flow meter **47**. Tank **14** can be drained using a valved flow line **21**. Line **21** has valve **55**. The water in tank **14** interior **16** can be transmitted via flow line **15** to pump **24**. Pump **24** discharges to flow line **26**. Flow line **26** can have valve **27** and flow meter **25**. The fill can be metered by an electronic flow meter. Pump **52** receives flow from drum **12** interior **13** via flow line **28**. Pump **52** discharges to flow line **31** with flow meter **53**. At tee fitting **30**, line **31** connects to

line **32**. Line **32** has valve **29**. Line **31** has valve **36** downstream of tee fitting **30** (see FIG. **1**). Line **32** joins line **48** at tee fitting **39**. Line **26** joins line **48** at tee fitting **54**. Line **33** is a drain line having valve **34**. Flow line **37** joins line **31** at tee fitting **35**. Line **37** has valve **38**.

[0057] FIGS. **2-7** show the sequence of operation or method of the present invention. In FIG. **2**, the drum **12** interior **13** is initially filled with selected fabric articles to be cleaned, such as linen articles. Water in the tank **14** is transmitted via the flow line **15** to the drum **12** interior **13** to provide an initial liquor ratio of about four (4) pounds (1.8 kg) liquor per pound (kg) of fabric articles or linen, plus absorbed water for washing. In FIG. **2**, valve **50** is closed. Valve **27** is open. Fresh water can be replenished in tank **14** after filling drum **12**.

[0058] In FIG. **3**, wash water is recirculated using a second pump **52**. Pump **52** receives flow from drum **12** interior **13** via flow line **28**. Flow line **28** discharges into flow line **31** which has valve **36**. Valve **38** is also closed. Line **31** has tee fitting **30** joining line **31** to line **32**. Line **32** connects to line **48** at tee fitting **39** which recirculates flow back to drum interior **13**. In FIG. **3**, pump **24** is off. Valve **27** is closed. Valves **36**, **38** are closed and valve **29** is open. Valve **50** is closed. Fluid thus recirculates from interior **13** to pump **52** and then back to interior **13**. Flow meter **53** can be provided in flow line **31**. Water in line **48** can enter drum interior **13** via an inlet nozzle **65** on the door of drum **12**. This step preferably achieves equilibrium quickly.

[0059] FIG. **4** illustrates that some water can be discharged (intermediate extract) from interior **13** using line **33**, opening valve **34**. After the washing step of FIG. **3** and the extract of FIG. **4**, rinsing water is then flowed into interior **13** via an inlet nozzle or inlet orifice (see FIG. **5**).

[0060] Table 1 below provides examples of flow rates, quantity of rinse water and rinse time in minutes for washer extractors of differing capacity. Washer extractor capacity is given in pounds (lbs) and kilograms (kg). Quantity of rinse is given in gallons (gal) and liters. Flow rates are in gallons per minute (GPM) and liters per minute (LPM).

Washer Extractor Capacity		Single Bath Rinse Liquor	Total Pulse Rinse Liquor	Quantity of Rinse Water		Pulse Rinse	Flow Rate in 120 Seconds	
Lbs	Kg	Ratio	Ratio	Gal	Liters	Time	GPM	LPM
50	23	6	12	72	272	2 minutes	36	136
125	57	6	12	180	680	2 minutes	90	340
275	125	6	12	396	1496	3 minutes	132	499
450	205	6	12	647	2447	4 minutes	162	612
600	273	6	12	863	3263	5 minutes	173	653

[0061] Rinsing or "pulse flow" rinsing is shown in FIG. **5**. In FIG. **5**, the pump **24** is receiving water from the operating sump or tank **14** and flow line **15**. The pump **24** discharges water through flow line **26** and valve **27** to flow line **48** and then into the interior **13** of drum **12**. Pump **24** can have a flow rate, for example, of High Velocity **50** to 150 GPM (568 LPM) depending upon the capacity of the washer. In FIG. **5**, the valve **50** of flow line **48** is closed. Second pump **52** is also operating/pumping in FIG. **5**. Pump **52** receives flow from interior **13** of drum **12** via flow line **28**. The pump **52** discharges that received water into flow line **31** and then into flow line **37** at tee fitting **35**. In FIG. **5**, the valves **36** and **29** are closed so that flow from pump **52** enters flow line **37** and is discharged to sewer. Valve **38** is open in FIG. **5**. The pump **24** provides a fixed flow rate and programmed quantity of incoming flow or liquor into the interior **13** of drum **12**. The pump **52** operates at a variable flow rate to maintain the programmed liquor to fabric articles ratio of about 6 liters of water per kilogram of fabric articles (or any other desired ratio of liquor to fabric articles). In other words, the pump **52** is removing a smaller (or larger) volume of water from the interior **13** of drum **12** then is being transmitted to the drum interior **13** by the pump **24**. Thus, the level of water within the drum interior **13** in FIG. **5** increases (or can be decreased), elevating the liquor to goods/fabric articles ratio from an initial ratio of about 4:1 to an elevated ratio of about 6:1, 7:1, 8:1 or 9:1 (or if desired, lowering the ratio). The elevated ratio can be anywhere between about 5:1 and 10:1. The pumps **24**, **52** can be computer programmed to maintain any desired liquor to fabric articles ratio. For example, when the level in the drum **12** reaches a liquor ratio of 6:1, pump **52** can turn on and vary its flow rate to maintain the level. This can create an overflow rinse until a preferably programmed quantity of water is pumped. The programmed quantity of water can be typically the amount equivalent to 2 or 3 rinses.

[0062] In FIG. **6**, finishing chemicals **40** are injected after the liquor to goods/fabric articles ratio is lowered (e.g., from about 6:1 to about 4:1) over time. This can be accomplished by deactiving the pump **24** and using the pump **52** to slowly lower the liquid level **45** within drum **12** interior **13** (see arrows **42**, FIG. **6**). The finishing chemicals **40** are injected (see arrow **41**, FIG. **6**) after the liquor ratio of about 4:1 is achieved. In FIG. **6**, water discharged from interior **13** into flow line **28** is pumped using pump **52** to flow line **31** and then to flow line **37**. Valves **29**, **36** are closed. Valve **38** is open.

[0063] FIG. **7** represents a final extract step after rinsing. In FIG. **7**, the disposition of final extract liquor is decided based on chemical content. Water can either be discharged through flow line **33** to sewer or alternatively recycled, pumped back to sump **14** via flow lines **28** and **31**. That saved, extracted water of FIG. **7** can then be used during the next washing of fabric articles (FIGS. **1**, **2**). The flow meters **25**, **47**, **53** can be used to monitor flow and thus enable maintenance of the desired flow rates of pumps **24**, **52** and the desired liquid levels within interior **13**. In order to extract and recycle maximum rinse water from the fabric articles in FIG. **7**, pump **52** can be a column pump. In FIG. **8**, column pump **60** has pumping unit **61** driven by an electric motor **62** receiving water via flow line **28**. Pumping unit **61** is connected to electric motor **62** via a vertical pump shaft **63** housed in a cylindrical housing **64**. Such column pumps **52** are commercially available. The pumping unit **61** is able to "wait" for trickles of water to fill it toward the end of extraction of water during the extraction cycle. Thus, final minute amounts of water are recycled as the pumping unit is repeatedly but at intervals filled, primed and the water pumped.

[0064] The comparison between a Standard washer and a Pulse Rinse washer (single bath; light soil; no bleach) is seen in the following tables:

Example washer Capacity (Lbs) = 250 (113.4 kg)
Light Soil No Bleach

Conventional					PulseRinse				
Op	Time	Fill/Drain Time	L/R	Water Source	OP	Time	Fill/Drain Time	L/R	Water Source
Break	8	2	4	F	Break	8	2	2	PFT (50% Fresh) + RecircOne
Rinse	2	2	6	F	Intermed Extract	2			
Rinse	2	2	6	F	PulseFlow	3	1	6	PFT (50% Fresh)
Rinse	2	2	6	F	Sour	3		4	Water left from PFT Step + RecirOne
Sour	5	2	4	F	Extract	8			Water goes to PFT for Next First Op
Extract	8	2							
	27	10	26			24	3	12	
Total Time	37		26	Total Gals: 886 Total Liter: 3353.9		27		12	Total Gals: 409 Total Liter: 1548.2

Light Soil No Bleach

Conventional				PulseFlow			
Op	Time	L/R	Water Source	OP	Time	L/R	Water Source
Break	8	4	F	Break	8	4	PFT + RecircOne
Rinse	2	6	F	Intermed Extract	2		
Rinse	2	6	F	PulseRinse	3	12 to 18	PFT
Rinse	2	6	F	Sour	3	4	Water left from PFT Step + RecirOne
Sour	5	4	F	Extract	8		Water goes to PFT for Next First Op
Extract	8						
	27	Plus 5 F/D	34		24	Plus One F/D	

[0065] The conventional formula uses fresh water for all fills; each rinse is drained to a sewer and then refilled with fresh water, using extra fresh water and more time; and the extracted water goes to a sewer. The PulseRinse formula reuses water for all fills; combines all three drains into one step, therefore saving time and water; and the water from the sour and extract step are reclaimed.

[0066] The comparison between a Standard washer and a Pulse Rinse washer (heavy soil; with bleach) is seen in the following table:

Heavy Soil, With Bleach

Conventional				PulseFlow			
Op	Time	L/R	Water	OP	Time	L/R	Water
Flush	8	6	F	Flush	1	6	PFT + RecircOne + Drain to Sewer
Break	2	4	F	Break	10	4	PFT + RecircOne
Flush	2	6	F	Intermed Extract	1		Water to Sewer
Flush	2	6	F	PulseRinse	2	12	PFT
Suds	5	4	F	Suds	4	4	Remaining water from PF Step

-continued

Heavy Soil, With Bleach							
Conventional				PulseFlow			
Op	Time	L/R	Water	OP	Time	L/R	Water
Flush	8	6	F	PulseRinse	2	12	PFT
Flush	27	6	F	Bleach	8		Remaining water from PF step + RecircOne
Bleach		4	F	PulseRinse	3	12	PFT
Rinse		6	F	Sour/AC	2	4	Water left from PFT Step + RecircOne
Rinse		6	F	Extract	8		
Sour/AC		4	F				
Extract	8						
	47	Plus 11 F/D	66		41	Plus 2 F/D	
			44.5				
			21.5	Estimated Time Saving = 33%			

The conventional method requires 11 fill/drain steps, whereas the PulseRinse method requires 2 fill/drain steps.

[0067] The following tables show a comparison of parameters for different washing programs and different types of soil:

		gewaschen Milnor/ washed Milnor		gewaschen Milnor PF/ washed Milnor PF			
		Programm 1/ program 1		Programm 1/ program 1		Programm 10/ program 10	
		Relative Flecks?rke/intensity of setting					
Nr./ No.	Fleckarten/ Type of soil	Mitteiwert/ Average value	Standard-abweichung/ Standard deviation	Mitteiwert/ Average value	Standard-abweichung/ Standard deviation	Mitteiwert/ Average value	Standard-abweichung/ Standard deviation
1	Currysauce/ Curry sauce	4.02	10.68	4.68	12.42	3.87	10.27
2	Expresso/ Expresso	4.66	10.25	5.58	23.03	4.43	18.29
3	Rinderfand/ Beef stock	0.59	1.44	1.59	3.84	0.79	1.91
4	Rotwein/ Red wine	0.82	33.04	7.58	36.73	7.36	35.68
5	Make-up/ Make-up	40.28	84.28	41.21	86.23	39.85	83.38
6	Blut/ Blood	15.71	39.61	23.89	60.25	18.64	47.01
7	Schokoladene/ Chocolate ice	4.53	10.93	8.20	19.38	6.12	14.46
8	MotorOil/ Motor Oil	37.06	84.39	38.06	86.68	37.08	64.44
9	Kürbis?n?/ Pumpkin seed oil	19.44	58.91	20.64	62.55	22.21	67.30
10	Spinat/ Spinach	10.00	19.22	13.70	26.32	13.71	26.34

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		Ergetnisse nech 50 zyiden/ Results after 50 cycles				
		Milnor Programm 1, Milnor program 1 Probe/Sample		Milnor PF Programm 1/ Milnor PF program 1 Probe/Sample		Anforderungen RAL-GZ 992/ Requirements
Prufkriterien/Parameters		1	2	1	2	RAL-GZ 992
Festigkeitsminderung/ Strength reduction		2.8	4.7	0.4	7.3	≤30.0
Chemische Faserscl?adigung/ Chemical fibre deterioration		0.1	0.2	0.4	0.4	≤1.0
Gewet?inkrustation/ Fabric encrustation		0.1	0.1	0.1	0.1	≤1.0
We?queli?t Whiteness quality	We?rad (WG-Wert)/ Degree of whiteness	236	—	236	—	>170
	Fa?onabweichungszahi (FAZ)/ Colour deviation number (CDN)	1.55	—	1.73	—	R-1.5 bis/to G 2.49
	Grundweie?wert (v-Wert)/ Basis whiteness quality (p-value)	93	—	93	—	>85

	Wassarverbraunchin Liter/ Water consumption in liter	
Waschmaschine/Washing extractor	Pro kg Wascha/ per kg textile	Waschvorgang gesamt/ Total washing cycle
Milnor Programm 1/Milnor program 1	21.4	428
Milnor PF Programm 1/Milnor PF program 1	6.5	130

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PARTS LIST

[0068]

Part Number	Description
10	washer extractor apparatus
11	machine
12	drum
13	drum interior
14	tank/sump
15	flow line
16	tank interior
17	fresh cold water source
18	influent flow line
19	influent flow line
20	fresh hot water source
21	drain line/valved flow line
22	valve
23	valve
24	pump
25	flow meter
26	flow line
27	valve
28	flow line
29	valve
30	tee fitting
31	flow line
32	flow line
33	drain line
34	valve
35	tee fitting
36	valve
37	flow line
38	valve
39	tee fitting
40	chemical injection/finishing chemicals
41	arrow

-continued

Part Number	Description
42	arrow
45	dotted line/fluid level
46	flow line
47	flow meter
48	flow line
49	flow line
50	valve
51	valve
52	pump
53	flow meter
54	tee fitting
55	valve
60	column pump
61	pumping unit
62	motor
63	pump shaft
64	cylindrical housing
65	inlet nozzle

[0069] All measurements disclosed herein are at standard temperature and pressure, at sea level on Earth, unless indicated otherwise. All materials used or intended to be used in a human being are biocompatible, unless indicated otherwise.

[0070] The foregoing embodiments are presented by way of example only; the scope of the present invention is to be limited only by the following claims.

1. A method of washing fabric articles, comprising the steps of:

a) providing a reservoir of washing liquid;

b) providing a washer extractor having an interior for holding fabric articles;

c) placing fabric articles to be washed in the interior of the washer extractor;

d) pumping the washing liquid from the reservoir to the washer extractor interior with a first pump;
e) adding washing chemicals to the washer extractor interior while it is filled with washing liquid and fabric articles;
f) transmitting rinse water to the washing extractor interior within a selected time interval with said first pump;
g) withdrawing the rinse water from the washer extractor interior with a second pump;
h) wherein a controller maintains a selected fluid level in said reservoir in steps "f" and "g" by adjusting the flow rates of one or both of said pumps.

2-4. (canceled)

5. The method of washing fabric articles of claim **1** wherein water consumption is between about 1 and 2 gallons (8 and 16 liters) per pound (kg) of processed fabric articles.

6. The method of washing fabric articles of claim **1** wherein the time interval of step "f" is between about one-two minutes.

7. (canceled)

8. The method of washing fabric articles of claim **1** wherein the ratio of pounds (or kilograms) of washing liquid to pounds (or kilograms) of fabric articles is between 3 to 1 to 5:1, plus absorbed water.

9. A washer extractor apparatus, comprising:
a) a washer extractor for holding fabric articles to be washed in a volume of a washing liquid having an associated reservoir and a washer drum with an extractor interior;
b) a reservoir having a flow line that enables transmission of washing liquid from the reservoir to the washer extractor interior;
c) a first pump at a first elevation that enables flowing of rinse fluid to the combination of fabric articles and washing liquid at a rate of between about 30 to 700 gallons (114 to 2,650 liters) per minute for a selected time interval;
d) a second pump at a second elevation lower than said first elevation that enables extraction of excess liquid from the washer extractor in order to maintain a selected volume of liquid in said interior and a first liquor ration; and
e) a controller that enables a change in the volume of fluid being pumped by the second pump to a flow value that is different from the volume of fluid pumped by the first pump so that the fluid level in the drum can be changed to provide a new and different liquor ratio.

10. The washer extractor of claim **9** further comprising a flow line for adding chemicals to the washer extractor interior.

11. The washer extractor of claim **9** wherein water consumption is between about one-half and two gallons (4 and 16 liters) per pound (kg) of washed and fluid extracted fabric articles.

12. A method of washing fabric articles, comprising the steps of:
a) providing a reservoir of liquid;
b) providing a washer extractor having an interior for holding fabric articles;
c) placing fabric articles to be washed in the interior of the washer extractor;
d) pumping the liquid from the reservoir to the washer extractor interior with a first pump, wherein the washer extractor interior has a liquid upper surface;
e) adding washing chemicals to the washer extractor interior;
f) transmitting rinse water to the washing extractor interior at a rate of between about thirty and seven hundred gallons (114 to 2,650 liters) per minute; and
g) extracting liquid from the washer extractor during step "f", wherein excess liquid that has been added in step "e" is discharged via an effluent flow line.

13-15. (canceled)

16. The method of washing fabric articles of claim **12** wherein water consumption is between about one-half (½) and two (2) gallons (4-16 liters) per pound (kg) of processed fabric articles.

17. The method of washing fabric articles of claim **12** wherein the time interval of step "f" is between about one and two minutes.

18. (canceled)

19. The method of washing fabric articles of claim **12** wherein the ratio of pounds (or kilograms) of washing liquid to pounds (or kilograms) of fabric articles is about 4 to 1, plus absorbed water.

20. The method of claim **1** wherein the withdrawn liquid of step "g" is transmitted to the reservoir of step "a".

21. The apparatus of claim **11** further comprising a flow line for enabling transmission of the extracted liquid to the reservoir.

22. The method of claim **12** wherein the extracted liquid of step "g" is transmitted to the reservoir of step "a".

23. The method of claim **1** wherein at least some of the withdrawn liquid of step "g" is re-circulated to the reservoir.

24. The apparatus of claim **9** further comprising a re-circulation flow line connecting the washer extractor to the reservoir, wherein said re-circulation flow line enables transmission of at least some of the extracted liquid to the reservoir and wherein the said second pump is in said re-circulation flow line.

25. The method of claim **12** wherein at least some of the extracted liquid of step "g" is re-circulated to comprise at least a part of the rinse water of step "f".

26. The apparatus of claim **9** further comprising a re-circulation flow line that conveys all or part of said excess liquid to said reservoir.

27. The method of claim **1** further comprising placing the second pump below the first pump.

28. The method of claim **1** further comprising placing the washer extractor interior below the first pump.

29. The method of claim **1** wherein the second pump is a column pump.

30-33. (canceled)

34. The method of claim **1** wherein the reservoir is refilled with rinse water after step "d".

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