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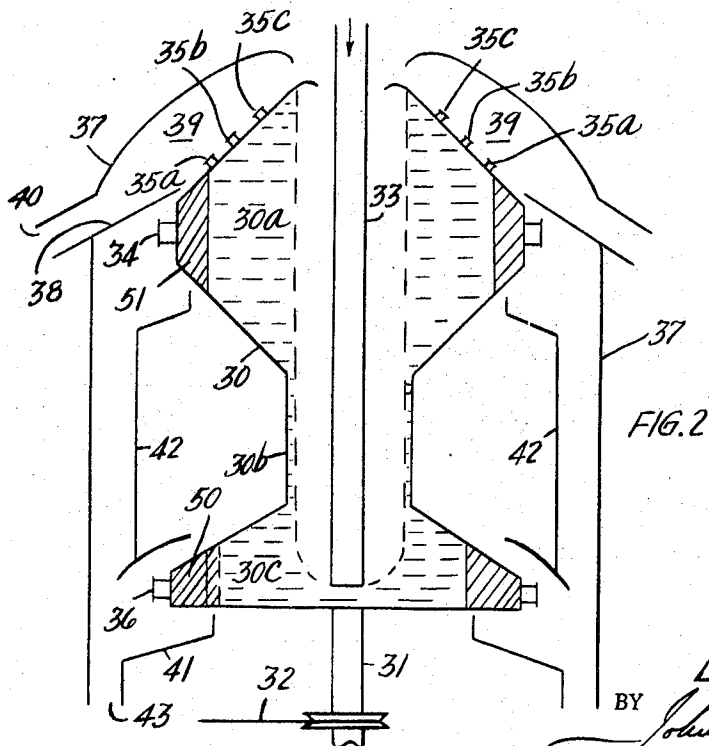
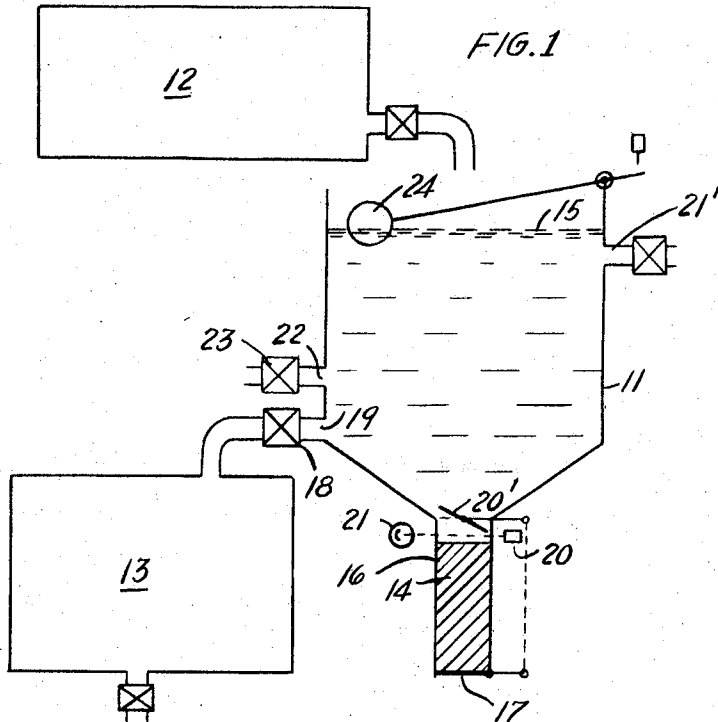
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3,353,378

APPARATUS FOR CLEANING CLOTHES AND TREATING WASH LIQUID

Original Filed May 4, 1961

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

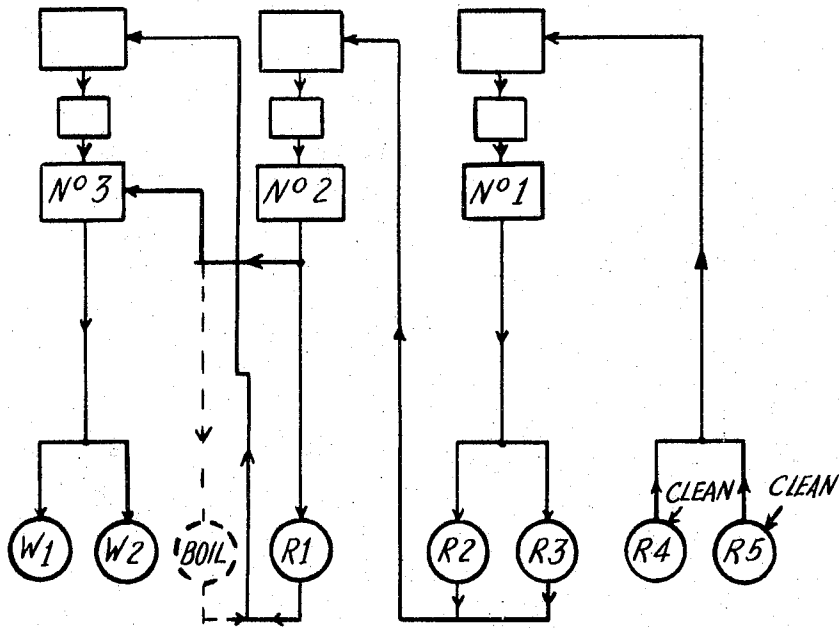


FIG. 3

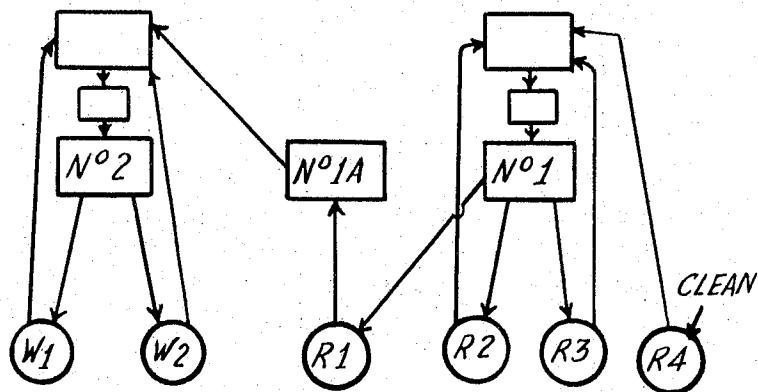


FIG. 4

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3,353,378

APPARATUS FOR CLEANING CLOTHES AND TREATING WASH LIQUID

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Continuation of application Ser. No. 107,681, May 4, 1961. This application Sept. 14, 1965, Ser. No. 494,292
7 Claims. (Cl. 68—18)

This application is a continuation of copending application Ser. No. 107,681, filed May 4, 1961, now abandoned.

The present invention relates to clothes washing and more particularly to apparatus for separating re-usable water or suds from the dirt, lint and other foreign matter contained in water withdrawn from a washing machine whereby it may be re-used. The invention is particularly applicable to commercial laundries but can also be used in conjunction with domestic washers.

According to one aspect of this invention, the dirty water removed from a washing machine is fed to a separating device in which at least the greater part of the loose dirt, lint and scum are separated from the liquid so that the water, rinse water or soapy water, is re-usable. This re-usable water is either fed to a draw-off storage tank from which it can be withdrawn for re-use in the same or a different washing machine, or it may be directly fed back into a washing machine.

In commercial laundries it is usual for the clothes to be washed in a series of stages. In the first break or soaking stage the main dirt particles are loosened and after a period of 5 to 10 minutes the wash liquid is withdrawn and the machine recharged with soapy water to effect the second or washing stage. This lasts for about 10 to 15 minutes after which the washing water is withdrawn and the clothes are submitted to, for example, three rinsing stages each of about 3 to 5 minutes duration, there being a water change between each rinse. In the rinsing stages the water may be slightly acidified in order to neutralise any excess alkali used in the washing stages.

According to one feature of this invention, two or more separating units and associated storage tanks are provided, the separated liquid being fed back into the same or a different machine either in the same or a different stage. Thus for example a first or washing separating unit may be provided for removing dirt from wash water removed from the first or second stage of a battery of washing machines, the liquid in the draw-off storage tank associated with this unit being fed back to the different machines for carrying out the first and second washing stages therein. A second or rinse separating unit may be provided for cleaning rinse water discharged from the machines and fed back to the machines for further rinsing. Preferably the final rinse is effected with clean water which when discharged or pumped out of a machine after the final rinse can be discharged into the dirty water storage tank of the rinse separator to top up for the water lost, for example the water remaining in the clothes. Water from the draw-off storage tank or tanks of the rinse separator may be used for topping up the liquid in the washing separator circuit. Or the water discharged from the first rinse may be fed to the dirty water storage tank of the wash water separator. If necessary soap may be added during any such transfer to maintain the soap concentration in the wash water circuit, and any acidity may be neutralised during the transfer from the rinse circuit to the wash circuit, if this should be necessary. Additional soap may, of course, be added in the separated water or in the washing machine during a washing stage in order to maintain the required soap concentration for washing.

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A further feature of the invention consists in a separating device for separating the dirt and scum from the re-usable water which operates by gravity. In this device the dirty water removed from a washing machine is fed to a separating tank in which the heavy dirt falls to the bottom of the tank and the greases, lint and scum (of light material) float to the surface of the liquid therein, means being provided for drawing off the re-usable liquid between the precipitated dirt and scum layer. The drawn off liquid is fed either directly into a washing machine or to a draw-off storage tank from which it may be drawn off from time to time for re-use in a washing machine.

A further feature of the invention consists in a separator device which operates by centrifugal action. In this device the dirty water from the washing machine is fed, either directly or via a storage tank or separating tank as above described, to a bowl or drum which can be rotated, preferably about a substantially vertical axis. The bowl or drum may conveniently be of cylindrical, part-spherical, conical or double conical form. By rotating the bowl at an appropriate speed the dirt will be thrown outwardly by centrifugal force and may be separated from the re-usable liquid, for example by drawing off the clean liquid from an inner zone of the rotating bowl or drum. Alternatively the bowl may be provided with openings or valves through which the dirt may be discharged to leave only the clean liquid which can be fed to a storage tank for re-use. In the case of a bowl having its maximum diameter at its upper rim, the dirt may be discharged over the top rim. The speed is adjusted or increased to achieve maximum separation.

Generally speaking the centrifugal type of separator has a larger capacity than the gravity type, and the selection of which type of separator is employed at a particular stage of a washing installation may depend on the time available before the dirty water fed to a separator is required for use. If desired, a separator unit may comprise both gravity and centrifugal separation means, the latter being brought into use at times when increased capacity is required.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings, in which:

FIGURE 1 is a schematic view, in section, of a gravity type separator.

FIGURE 2 is a schematic view, in section, of a centrifugal type of separator.

FIGURE 3 is a diagram of one embodiment of a washing installation according to the invention.

FIGURE 4 is a diagram of another embodiment of washing installation.

FIGURE 1 shows diagrammatically the construction of a separator unit which effects separation by gravity.

The device comprises a separating tank 11. The dirty water pumped from a washing machine is discharged into a dirty water storage tank 12 from which it can be fed to the separator 11, the clean liquid separated in the tank being drawn off into a draw-off storage tank 13.

When the dirty liquid is fed into the separator tank 11, the heavy dirt 14 falls to the bottom of the tank and the greases, lint and scum 15 float to the surface of the liquid. Preferably the base of the separation tank inclines towards a drain outlet constituted by a chamber 16 in which the heavy dirt collects, the bottom of the chamber being provided with a valve 17.

The cleaner liquid layer between the scum and the heavy dirt, which is re-usable and may contain useful suds, is drawn off through a valve 18 in a draw-off pipe 19 connected to the tank 11 at a level above the dirt precipitate.

The drain valve 17 may be opened from time to time,

for example daily or at the end of a separation cycle, depending upon the amount of heavy dirt collecting in the drain chamber 16, in order to discharge the heavy dirt. If desired, means may be provided for detecting when the dirt precipitate reaches a predetermined high level, the detecting means operating automatic mechanism for opening the valve 17. For this purpose an appropriate level detecting device may be provided, such as light source 20 and photoelectric cell 21, the light beam, being projected across the drain chamber 16 (which may be transparent or provided with windows) at the appropriate level and on to the photocell. When the dirt level rises above the light beam, the photocell is caused to operate to open the drain valve. Time delay means may be provided for automatically closing the valve after a predetermined time interval. The drain valve 17 may be associated with a second valve 20' at the top of the drain chamber 16 which closes when the drain valve 17 opens, whereby only the contents of the drain chamber will be discharged through the drain valve, and turbulence in the tank is avoided.

Scum may be removed from the separator tank 11 by filling the tank to a level such that the scum rises above the top edge of the tank or above a discharge opening or openings 21' (round, square, elongated or other desired shape) at or near the top of the tank. According to a modification a discharge opening (or several openings around the tank) for the scum may be arranged near the bottom of the tank as indicated at 22 and be controlled by a valve 23 or the like which is kept closed while the cleaner liquid is being drawn off. When the drawing off of the cleaner liquid is stopped with the scum layer above the scum draw-off opening or openings 22, the scum draw-off valve 23 is opened to draw off the top layer of liquid including the scum. This may be discharged to the drain or through a filter device for separating the scum from liquid, which latter can be returned to the draw-off storage tank 13.

By constructing the valve 18 associated with the draw-off opening 19 (or series of openings at the same level) as a two-way valve, the same draw-off opening may be used for both clean liquid and scum. After the cleaner liquid has been drawn off, the valve is changed over to draw off the scum and to discharge it into the drain or a filter unit.

Means may be provided, actuated by the level of the liquid and/or the level of the underside of the layer of scum and light dirt floating on the liquid in the tank, in order automatically to close the draw-off valve 18, or to change it over as above described, when the liquid in the separator tank 11 has been drawn off to such an extent that there is a risk that the scum and other floating dirt could also be drawn off into the draw-off storage tank 13 if the drawing-off were continued further. Or the control means may actuate a signal under such conditions to warn the operator that the draw-off valve should be manually closed. Such control means is indicated in the drawing as comprising a float-operated device 24 which actuates a mechanism or switch in accordance with the liquid level in the separator tank. Other control means may be used, such as a photoelectric device.

In operation, the separator tank is filled with dirty water and allowed to stand for a sufficient time to allow the heavy dirt to precipitate and the scum to rise to the surface. If desired, the liquid may be submitted to vibration (at stages of time after the admission of the dirty water) to displace the dirt particles and facilitate their sinking or floating to effect separation. Such vibration may be effected by a mechanical vibrator connected to the tank and/or by causing controlled, small and distributed quantities of air bubbles to pass up through the liquid. During separation, if the level of the precipitated dirt rises above the predetermined level, it is automatically discharged through the drain as above described. After the required separation time, the liquid layer containing the cleaner liquid between the dirt precipitate and the scum is drawn off through the draw-off pipe 19 at a level above the dirt precipitate. When the scum layer approaches the level of

the draw-off pipe 19, the draw-off valve 18 is closed, automatically or manually, and a fresh supply of dirty water is fed into the tank and the separation cycle restarts.

If desired, the supply of dirty water into the tank 11 may be continued until such time that the scum layer from a previous separation is raised above the discharge openings 21' at or near the top of the tank through which this top layer of liquid and scum overflows either into the drain or a filter or filters through which the re-usable liquid passes while the heavy scum remains trapped in the filter.

It will be understood that the gravity separator device described may be modified in various ways. For example, instead of drawing-off the re-usable liquid through a draw-off pipe by gravity, it may be drawn off by a pump or syphon arrangement.

FIGURE 2 shows a centrifugal type of separator according to the invention.

The device comprises a bowl 30 mounted for rotation about a shaft 31 which may be driven by a vehicle speed motor through the belt drive 32. The bowl comprises an upper chamber 30a of double conical shape which connects via a neck portion 20b with a lower conical chamber 30c. The top of the bowl has a central opening through which extends a pipe 33 by means of which dirty liquid can be fed into the bowl. Around the maximum periphery of the upper chamber 30a are arranged a series of valves 34 and along the upper conical wall of the upper chamber 30a are arranged a plurality of valves 35a, 35b and 35c disposed in annular rows. Around the periphery of the bottom chamber 30c are arranged a row of valves 36.

Surrounding the bowl is a stationary shell 37 which is divided into a number of compartments by means of partitions. An annular partition 38 is arranged approximately opposite the center of the upper chamber 30a and extends inwardly to adjacent the valve 35a to form an upper compartment 39 adapted to collect the cleaner water which will be discharged through the valves 35. The compartment 39 is provided with a discharge outlet 40 which leads to a draw-off storage tank, such as 13 in FIGURE 1. The bottom of the shell 37 extends below the bottom of the bowl and forms an annular tray 41 therearound to collect dirt and liquid discharged through the valves 36. Dirt and liquid discharged through the valves 34 enters a compartment defined by an inner shell 42 which directs the discharged matter into the tray 41. The tray 41 is provided with a drain outlet 43.

The valves 34, 35, 36 may be centrifugally operated. For example, they may be acted on in one direction by a spring and in the opposite direction by centrifugal force. The valves 35 are normally closed by the spring and opened by centrifugal force whereas the valves 34 and 36 operate in the reverse direction, being opened by springs and closed by centrifugal force.

The device operates as follows:

With the bowl rotating at a relatively high speed, dirty water is introduced into the bowl through the pipe 33. It is immediately thrown outwards by centrifugal force into the bottom chamber 30c, the heavier dirt being thrown out to the periphery of this chamber as shown at 50. As the chamber 30c becomes filled, further water will flow over the neck portion 30b and into the upper chamber 30a. Any dirt which passes up into this upper chamber will be thrown outwardly by centrifugal force as shown at 51. The inner layer of the hollow cylinder of liquid in the upper chamber will be relatively clean liquid.

By increasing the speed to that at which the valves 35 open, this cleaner liquid will be thrown out through valves 35 into the upper compartment 39 of the shell and fed by way of the outlet 40 to the draw-off storage tank. The separation will be continuous while dirty liquid is being fed to the bowl.

When such a quantity of dirt is built up in the chambers 30c and 30a as will be liable to interfere with the separa-

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tion, the drum speed is reduced. Valves 35 close and when the speed falls to a predetermined low value, the valves 34 and 36 open so that the dirt contained in the chambers 30a and 30c will be centrifugally discharged into the shell and conducted to the drain 43.

The device shown in FIGURE 2 may be operated in other ways. For example the valves 34 and 36 may be arranged to open at a predetermined speed, the speed being adjusted or increased until the major part of the loose dirt is separated off. Thereafter the bowl may be slowed down or stopped and the cleaner liquid drawn off in any convenient manner, for example through a hole in the bottom of the bowl, such as through the bore of the driving shaft. With this arrangement the separation is discontinuous. Alternatively, the bowl may be spun until the dirt is discharged and then further spun, if necessary at higher speed, in order that the cleaner liquid will be discharged, the dirty and cleaner liquids which are discharged in the two stages being selectively directed to the drain (or a filter) and the draw-off storage tank respectively. If desired, the bowl speed may be reduced between the two stages.

Instead of using centrifugally operated valves, valves may be employed which are mechanically actuated by a member on a stationary part of the machine co-operating, for example, through a ring, with a valve actuating member on the bowl. In another embodiment the valve members may be solenoid-controlled. The valve members may be interlocked with the means controlling the motor speed.

In the case of an upwardly tapering bowl, two rows of openings may be provided one above the other, the speed being adjusted to throw the dirt out of the lower row of holes. When the dirt has been discharged, the speed may be increased to throw the clean liquid out of both rows of holes, or if desired only out of the upper row if the lower holes are closed by a valve member, for example as described above.

In another embodiment the bowl may be closed at its top except for a central opening through which enters a pipe for supplying the liquid to be cleaned. The liquid is directed, or the bowl may incorporate deflectors, so that the spinning bowl will throw the liquid centrifugally outwards to provide a hollow central passage therethrough. The dirt is thrown outwardly towards the maximum diameter of the bowl, the inner layer of liquid being cleaner. The shaft driving the bowl is made hollow and preferably somewhat larger in diameter than the hole in the top of the bowl. With this separator the liquid to be cleaned may be fed continuously to the bowl, the heavy dirt and scum being thrown centrifugally outwards and the inner cleaner layer of liquid being drawn off through the hollow shaft. The bowl may be provided with valve controlled discharge outlets, the valves being centrifugally actuated so that, after a quantity of dirt has collected in the bowl, its speed may be increased to open the valves and discharge the dirt. The speed is then reduced until the valves close. The valves may alternatively be mechanically or electrically actuated as above described.

If the bowl is made of upwardly tapering form the discharge openings may be provided near the top of the drum and the speed may be adjusted so that no liquid or dirt is discharged through these holes even though liquid is continuously fed to the bowl and clean liquid is withdrawn through a hollow driving shaft at the bottom of the bowl. When the dirt is to be discharged the speed is increased to raise the dirt layer to discharge the dirt through the discharge opening.

Both kinds of separator, namely gravity and centrifugal, may be combined, the gravity form with its controls, which requires substantially no power for its operation being used normally and the centrifugal separator being brought into use in the event of additional cleaned water being required to meet a particular demand. The centrifugal separator may use the gravity separation tank for col-

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lecting the dirty and/or cleaned liquid thrown out of the bowl. For this purpose the bowl may be moved into a position within the separator tank and may be filled either from a separate pipe discharging dirty water from the machine or storage tank, or by immersing the bowl in the dirty water with which the separator tank is filled. The bowl may be raised from the liquids before spinning, or the tank may be emptied before the bowl is spun. Two or more bowls may be arranged one above the other on a common shaft and more than one driven shaft, each carrying one or more bowls, may be positioned in a tank.

When using a spinning bowl it is desirable to incorporate paddles, fins or the like to reduce slippage between the bowl and the water to ensure that the liquid will spin with the bowl. The paddles may be provided on the interior of the bowl and/or on a central rotating shaft.

In another modification, instead of rotating the bowl it is sufficient to cause the water to spin by means of rotating paddles, fins or the like within the bowl, the bowl itself remaining stationary.

In order to collect the dirt and direct it out through the discharge opening or openings in the bowl, there may be associated with the discharge apertures deflector plates or members, disposed around the trailing edges of the apertures relative to the direction of water rotation whereby the dirt spinning in the bowl, will be collected by these deflectors and guided into the discharge apertures. The deflectors may be curved to assist collecting the dirt. A deflector ridge may be provided around the bowl above a row of holes to trap the dirt and deflect it through discharge openings. Other holes may be provided above the ridge for discharge of cleaner liquid.

According to another embodiment of the invention, use is made of the fact that when the spinning water is suddenly slowed down or stopped, the heavy dirt swirls around the center of the bottom of the bowl and collects in the center thereof. The dirt may then be extracted through the bottom of the bowl (which may be coned or shaped to collect the dirt) and the cleaner liquid can be withdrawn after the dirt has been extracted or through apertures above the level of the dirt layer. This embodiment of the invention may be combined with the gravity separation tank by incorporating therein a rotating shaft of non-circular form, or carrying paddles or fins, in order to spin the dirty liquid in the separation tank to concentrate the heavy dirt on the bottom of the tank by the swirling motion when the shaft is stopped.

With such a spinning arrangement, the light dirt, lint and scum also swirls around the center of rotation at the top of the liquid, when rotation is stopped and can be separated off.

In another modification separation of the heavy dirt and the light dirt or scum may be effected in separate separators. Thus the light dirt and scum may be separated by flotation in a tank, and the heavy dirt separated in a centrifugal separator or by a swirling action separator. For example, the light dirt and scum may be separated off in the dirty water storage tank to which the dirty water is fed from the washing machine, the water containing the heavy dirt being fed from the bottom of the storage tank to a centrifugal separator, the scum remaining in the storage tank and being cleaned off periodically or from time to time in any of the manners above described.

Any scum remaining in the liquid after centrifugal separation will float to the surface of the liquid in the draw-off storage tank for cleaned liquid from which liquid is drawn off to refill the machines, the scum remaining in the draw-off storage tank being cleared out periodically or from time to time.

The invention not only results in a saving of soap but also of water, including hot water, thereby resulting in a saving of fuel required for heating the washing water. The only water which is lost need be that which is absorbed in the clothes after the final rinse. This is sub-

stantially clean water, and after removal from the clothes in the extractor, can be re-used in the washing and/or rinsing circuits.

The invention thus also provides a novel washing system which effects saving of water, soap and fuel. The amount of water consumed is only the amount of clean water required in the final rinse or the final rinses. Thus, for example, in a commercial laundry in which the clothes are submitted to two washing stages and five rinsing stages it is generally conceded that 350 gallons of water are required to wash 100 lbs of clothes. By means of the invention this can be reduced to about less than 100 gallons.

This will be explained with reference to FIGURE 3 which shows the manner in which the water will be circulated in a washing cycle. The washing stages are indicated by W1, W2 and the five rinsing stages by R1-R5 respectively. It will be understood that the circles indicated by the reference W1, W2 and R1-R5 are not separate machines but constitute various washing and rinsing stages of a single machine, and that the machine will be piped through multi-way valves (not shown) so that they can be supplied with cleaned water from the various storage tanks and can discharge the dirty liquid from each stage to the appropriate storage tank.

In a 100 lb. washing machine, each of the two final rinses R5, R4 requires about 70 gallons of water of which 26 gallons will be carried over in the clothes so that 44 gallons of clean water would have to be supplied to each of the 4th and 5th rinses, thus requiring an amount of 88 gallons of water. Water pumped out after these rinses will be clarified in No. 1 separator as above described and will be fed to storage tank No. 1. This water will then be used for rinses R2, R3 each of which will again take 44 gallons of water, the discharge from each rinse being cleaned in separator No. 2 and then to storage tank No. 2. Half of the water in storage tank No. 2 will be used in the first rinse R1 and the water recovered and clarified from the first rinse will be fed to No. 3 separator and storage tank, from which it will be used in the first and second washes W1, W2. Approximately 60 gallons of water will be required for the first wash, where the clothes are dry, and 14 gallons for the second wash W2 so that if there has been negligible loss on recovery there will be an excess in storage tank No. 3 which can be overflowed to waste. If desired, a proportion of water in storage tank No. 2 can be used in a boiling stage and after recovery and clarification fed to storage tank No. 3.

FIGURE 4 shows another circulation diagram with two washes W1, W2 and four rinses R1-R4. Clean water is used in the final rinse R4 and after recovery and clarification is fed to storage tank No. 1 from which it can be fed to the machine for effecting rinses R3 and R2, being recovered, clarified and returned after each rinse to storage tank No. 1. The water in storage tank No. 1 is then used for the first rinse R1 from which it is discharged to an intermediate storage tank No. 1A. The water from the first rinse R1 contains a relatively high proportion of alkali and as this is fed back to a separate storage tank No. 1A, the alkali does not contaminate the water in storage tank No. 1 which is used for the second and third (or any desired number of) intermediate rinses. Storage tank No. 2 serves for supplying water for the first and second washes W1 and W2 thereby conserving alkali and suds. Water from storage tank No. 1A may be used for topping up storage tank No. 2. It is not essential that storage tank No. 1A should have its own individual separator. It need merely be a storage tank for dirty water from the first rinse R1 which can be cleaned in the separator associated with storage tank No. 2.

For smaller washing machines, for example of 10 lbs. capacity and requiring only about 8 gallons of water

in the machine, the installation can be simplified and may require only one or two separators and storage tanks of about 8 gallons capacity. Normally about 40 gallons of water is required to effect the washing and rinsing. Even if by simplifying the installation some of the water used has to be overflowed to the drain, considerable saving can be effected. A heater may be associated with the draw-off tank to heat the water before it is fed to the washing machine.

By means of the invention it is possible to re-use the fluids both from the washing and rinsing stages, these fluids being cleaned immediately after use and stored in separate draw-off storage tanks, from which the liquid can be fed through appropriate control valves to the machines as required for re-use. The liquids may be circulated by pumping and/or gravity.

While the invention has been described in connection with washing machines using water, it can also be used in conjunction with dry cleaning apparatus, the separators being used to separate the dirt and other foreign matter, thus enabling the cleaning fluid to be re-used several times before filtering or distilling is necessary.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. An apparatus for washing clothes, by several washing and rinsing stages, the combination of a washing machine and a plurality of separating units for separating dirt from the water used for washing and rinsing, means for filling a washing machine with clean water for the last rinsing stage, means for passing dirty water from the last rinsing stage to a first separator unit, means for passing the cleaned water from said first separator unit to a washing machine for a previous rinsing stage, means for passing the dirty water from a previous rinsing stage to a second separator unit, and means for passing the cleaned water from said second separator unit to a washing machine for a washing stage, each of said separator units having storage means for storing cleaned water prior to passing the cleaned water to a washing machine and a bowl mounted for rotation about a substantially vertical axis at a speed which can be varied, the said bowl being shaped to form a chamber having at least one wall part inclined inwardly from its outer periphery, and having a plurality of first valves arranged around the maximum periphery of the chamber and a plurality of second valves arranged around said inclined wall and inwardly of the maximum periphery, the said first valves being normally open and being closed by centrifugal force and said second valves being normally closed and opened by centrifugal force exceeding that at which said first valves are closed, and means for selectively collecting the liquid discharged through said first and second valves respectively.

2. Apparatus as claimed in claim 1, wherein said bowl is shaped with an upper chamber defined by upper and lower walls inclined towards one another in the radially outwards direction, the lower end of said upper chamber connecting by a neck portion with a lower chamber of radial dimensions greater than said neck portion and having at least its upper wall inclined downwardly in the radially outwards direction.

3. Apparatus as claimed in claim 2, wherein a plurality of further valves are arranged around the periphery of said lower chamber, said further valves being normally open and being closed by centrifugal force.

4. An apparatus for washing clothes, by several washing and rinsing stages, the combination of a washing machine and a plurality of separating units for separating dirt from the water used for washing and rinsing, means for filling a washing machine with clean water for the last rinsing stage, means for passing dirty water from the last rinsing stage to a first separator unit, means for passing the cleaned water from said first separator unit to a washing machine for a previous rinsing stage, means for passing the dirty water from a previous rinsing stage to a second separator unit, and means for passing the cleaned

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water from said second separator unit to a washing machine for a washing stage, each of said separator units having storage means for storing cleaned water prior to passing the cleaned water to a washing machine and a separating tank having (1) a drain sump in the bottom thereof in which heavy dirt collects by gravitation, (2) a drain outlet valve for discharging said dirt, (3) a liquid draw-off valve connecting with the separating tank at a position near the bottom thereof and above the level of the sump through which cleaned liquid may be drawn off, and (4) a valve between the separating tank and the sump connected with the drain outlet valve for simultaneous operation so that the opening of one of said valves closes the other valve and vice versa.

5. Apparatus as claimed in claim 4, wherein means are provided for detecting the level of dirt and in said sump, the operation of said detecting means upon the dirt reaching a predetermined level above said drain outlet valve actuating a signal and/or opening the drain outlet valve.

6. Apparatus as claimed in claim 5, including a device responsive to the level of the liquid in the tank which actuates a signal and/or closes said draw-off valve when the liquid level falls close to the level of said draw-off valve.

7. An apparatus for washing clothes, by several washing and rinsing stages, the combination of a washing machine and a plurality of separating units for separating dirt from the water used for washing and rinsing, means for filling a washing machine with clean water for the last rinsing stage, means for passing dirty water from the last rinsing stage to a first separator unit, means for passing the cleaned water from said first separator unit to a

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washing machine for a previous rinsing stage, means for passing the dirty water from a previous rinsing stage to a second separator unit, and means for passing the cleaned water from said second separator unit to a washing machine for a washing stage, each of said separator units having storage means for storing cleaned water prior to passing the cleaned water to a washing machine and a separating tank having (1) a drain sump in the bottom thereof in which heavy dirt collects by gravitation, (2) a drain outlet valve for discharging said dirt, (3) a liquid draw-off valve connecting with the separating tank at a position near the bottom thereof and above the level of the sump through which cleaned liquid may be drawn off, and (4) a second draw-off valve connecting the separating tank at a level above said first draw-off valve and adapted, when opened, to draw-off the scum layer on the liquid in the tank.

References Cited

UNITED STATES PATENTS

782,065	2/1905	Shaler	210—513
2,130,817	9/1938	Shaw	68—18 X
2,263,095	11/1941	Lieberman	233—20 X
2,630,694	3/1953	Creswick	68—18
3,192,155	6/1965	Bready et al.	68—18 X

FOREIGN PATENTS

426,019	3/1935	Great Britain.
513,237	10/1937	Great Britain.

WILLIAM I. PRICE, *Primary Examiner.*