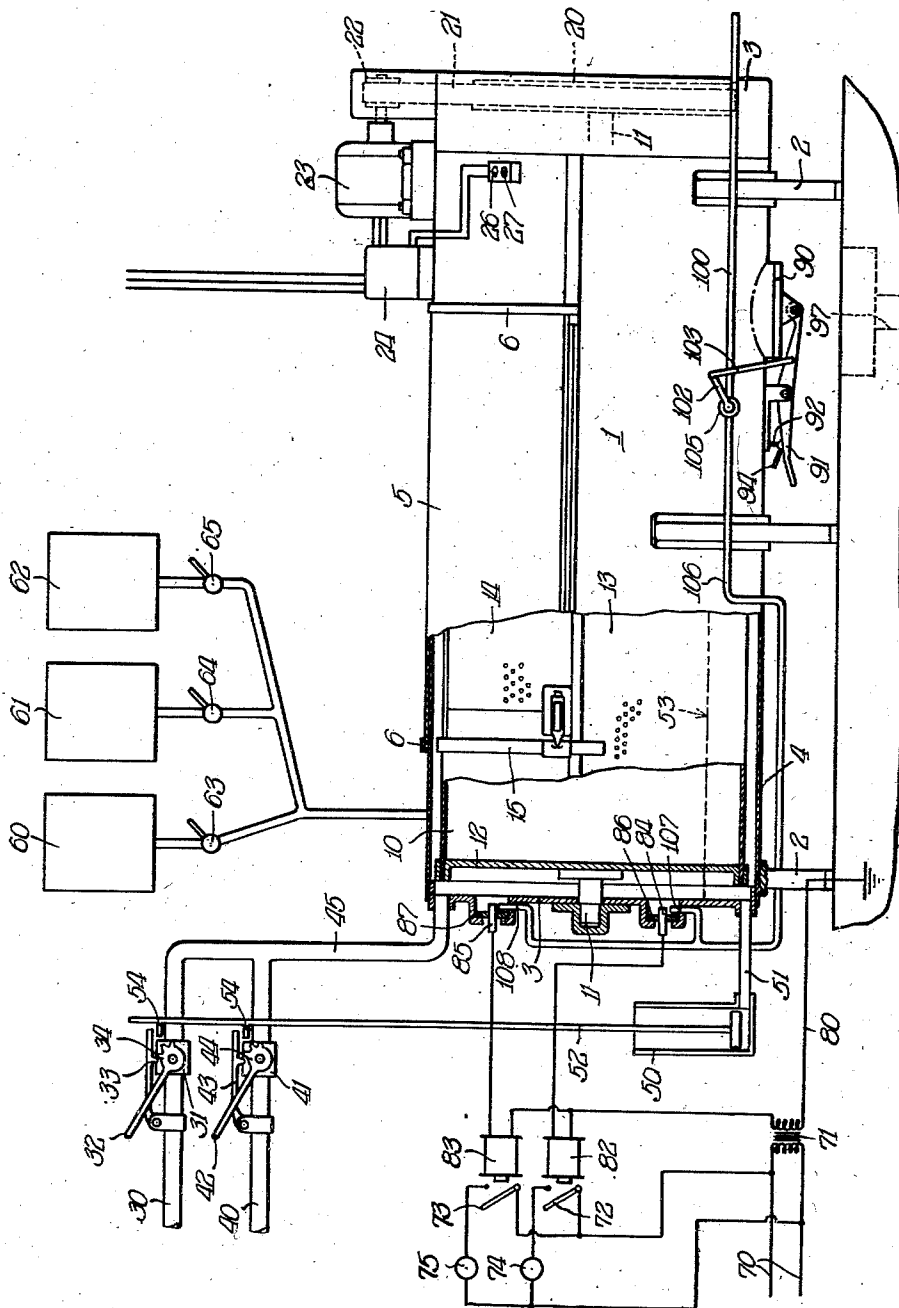


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ART OF CLEANING FABRICS

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ART OF CLEANING FABRICS

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The invention relates to a novel process of washing fabrics.

More especially the invention relates to a process by which textiles may be treated with soap and water to release soil present in the fabrics by agitating them a minimum length of time and using the minimum amount of detergent. The invention further contemplates setting up a routine of procedure which will assure, without any inspection of the clothes at the end of the suds treatment, that when the appropriate succeeding steps which include rinsing, bluing, souring, and at times bleaching are carried out, the resulting laundered fabrics will be clean by accepted standards regardless of their degree of initial soil.

It is an object of this invention to provide a novel process for washing fabrics in which the fabrics may be brought to such a condition during the washing operation that after subsequent treatments of washing, bluing and souring, and drying, predetermined standards of cleanliness will be attained while the amount of washing done and the quantity of detergent used will be the minimum required for the amount of soil present in the fabrics.

It is a further object to proportion the amount of washing and detergents to the amount of soil present without the need of inspecting or testing the fabrics either before, during, or after the washing operation, and without incurring the risk of having to repeat the entire process after the clothes have been rinsed and dried because the washing operation itself had been inadequate.

In the washing of clothes there is a very wide variation in the degree of soil present in successive batches. Consequently there are wide variations in the amount of detergent and in the amount of washing required to cleanse successive batches. This variation, however, cannot be satisfactorily estimated by any inspection of the fabrics either before or during washing.

In commercial laundering it is extremely desirable to reduce the washing operations to standards to be followed as a routine, but no satisfactory system has been available, since any fixed standard routine proposed, if sufficient to insure satisfactory results on badly soiled clothes would be wasteful of soap, water, and effort on less soiled clothes.

Furthermore, any standard routine suitable for less soiled clothes would not be satisfactory for badly soiled clothes. Clothes would not reach any acceptable standard of cleanliness at the end

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of the whole laundering operation, but only after the rinsing, bluing and souring, and bleaching operations are complete would this become evident. If, therefore, the first washing was inadequate, that fact would not be clearly manifest until the subsequent operations had been performed. To wash the clothes by an inadequate washing, therefore, is quite wasteful in that the washing must be repeated after the prolonged series of subsequent steps have been performed.

It is, moreover, important that the washing be conducted as fast as is consistent with attaining the results desired, and to this end it is important that in each washing stage, we use the maximum amount of soap which can be used efficiently. It is an object of this invention, therefore, to obtain a system by which each washing step may be standardized and still utilize the maximum soap which it is capable of being used efficiently.

It is an object of this invention to provide a standardized system of washing in which the amount of detergent and washing is automatically adjusted to the amount of soil so that, after all subsequent steps are performed, the desired standard of cleanliness will be attained.

It is known that in washing, more soap or detergent must be used in any treatment of the clothes than is theroretically necessary to combine with the soil present. This surplus produces a suds. In a horizontal axis washer of the type generally used in commercial laundry practice the tumbling of the clothes which are lifted out of the liquid by the ribs and fall back into the liquid traps air which tends to create bubbles in the liquid. These bubbles increase the depth of the suds blanket. It is also recognized that the reaction between the soap and all the soil in the clothes is not instantaneous but requires time.

The soils present in the fabrics are of various types ranging from dirt particles that do not adhere to the fabric and are readily washed off and soils like sugar that go into true solution to compounds that must first be broken down into other compounds that will combine with the soap and go into a colloidal suspension. Some of the soil will combine with the soap in a short time while other parts of the soil require a much longer time to combine. This is recognized in practice by building up a suds blanket at the beginning of each suds treatment, the suds blanket providing a storage of detergent that permits the combination of the less readily solu-

ble soil in the fabric with a detergent under continued agitation.

Commercial washers are normally operated at rated capacity and when thus operated, the bath is always carried to a fixed liquid level. In accordance with this invention, it has been discovered that we may determine another level somewhat above the liquid level, which may be called the initial suds level, which is relatively constant for any given machine if the soap be admitted to the washer at a fixed rate. And this is the level to which the blanket of suds rises when the amount of soap added is substantially the maximum that can be effectively utilized in that washing with clothes which bear that degree of soil. Thus this initial suds level coupled with the fixed rate at which the soap is added permits an approximate adjustment of the soap to the soil in the goods.

It is also possible to determine another suds level considerably higher than the initial suds level to which the blanket of suds will rise only when substantially all of the soil has been removed or neutralized by the soap to the point of leaving free soap in the solution. And this high suds level may be so coordinated with the initial suds level and the rate at which soap is supplied that the arrival of the soap at that level will very closely indicate the condition which the clothes will attain after they have been subjected to the subsequent operations.

While in the past soap and detergent have generally been fed by throwing in a bucket full of solid or liquid soap, the practice of this invention requires that the soap or detergent be fed in a form that permits immediate solution in the bath of a part at least of the soap, producing immediate reaction with some of the soils. Furthermore it is necessary that the soap or detergent, whether in solid or liquid form, be fed at a uniform rate so that the suds blanket can build up during the feeding of the soap and the soap feed stopped when the blanket reaches the suds level referred to above as the initial suds level. In practice it is found convenient to form a concentrated soap solution of a uniform strength and to feed this into the washer at a uniform rate. As the soap solution begins to flow into the washer the agitation therein distributes it throughout the bath and some action can take place between the soap just introduced and the soil immediately and while soap is still being fed to the washer.

Applicant has discovered that if the soap or detergent is fed to the washer at a selected rate and in a readily soluble form some of the more soluble soils will combine with the soap during the time the soap is being fed to the washer. Accordingly, if the detergent is thus fed at a selected rate until a given suds blanket is attained, the more soluble portion of the soil present will increase the length of time required to build up the blanket by combining with some of the soap immediately. This longer time of feeding soap will offset the loss of soap in the initial soap-soil reactions and also store in the suds a larger amount of detergent if the degree of soil is greater. This will be available during that agitation of the soiled fabric to combine with the soil slower to come off.

When the suds reaches the initial suds level the soap feed is shut off. It should be noted that feeding soap at a uniform rate at each operation until the suds level reaches a preset level is not synonymous with feeding a uniform quantity of

soap in each treatment. The amount fed is the amount needed to form the suds blanket plus the amount that is already combined during the feeding.

The last drops of soap to be fed before the shut-off have not gone into solution. When they do, they will temporarily build the suds blanket up above the initial suds level. But as the agitation is continued for a fixed length of time, the additional soil going into solution lowers the suds blanket below its initial blanket depth.

The initial suds level must be selected at such an elevation above the water level that it will store enough soap to combine with the amount of the soils present that go into solution or suspension after the soap feed has been cut off. It is the aim that at no time during any suds treatment will the suds completely disappear causing redeposition of the soil on the clothes.

The initial suds bath becomes so loaded with soil that no further cleansing action can take place. As this bath is dropped out of the washer and the process repeated with successive clean baths a new condition arises. After the soap feed has been cut off, the blanket decreases in depth for a time, but as the soil in the fabrics becomes exhausted no more soap is taken out of the suds.

The tendency for the agitation to beat in air already alluded to will cause the suds blanket to build up again.

It has been discovered that this increase in the depth of the suds blanket after the soap feed has been cut off in any standardized system of washing treatments such as we have described, may be used to determine when further agitation with soap and water may be dispensed with. Throughout the period of agitation after the feed of soap has been cut off, air is being trapped in the soapy bath forming bubbles. The combination of some of the soap with the soil draws upon the suds blanket so that the suds blanket decreases in thickness, despite the air beaten in, as the soil remaining in the fabrics combines with the bath.

The suds blanket will thus readily increase when the soil is exhausted so that the final suds level exceeds the initial suds level. Therefore, when the final suds level exceeds the level to which the initial suds level rose before shutting off the soap, the treatments with soap and water may be discontinued.

Since there is considerable sloshing about in the washer, in the preferred form there is a final suds level placed higher than the initial suds level. This higher level must be reached before the suds treatments are discontinued. A level to which the suds must rise is selected. This final suds level is placed sufficiently above the initial suds level to make the indication positive, avoiding an accidental or erroneous indication due to sloshing or other causes.

This indication that further treatment with soap may be dispensed with is not in itself an indication that the clothes are clean. Much of the soil still remains in the clothes. Some of it is in colloidal suspension or solution in the liquid held within the mass of the fabric by capillarity. Some of it has settled on the clothes as a deposit in the form of a soap-soil compound generally referred to as a curd. The clothes contain three times their own weight of water after draining so that the amount of soil held in suspension in the clothes may be considerable even after the bath is dumped.

Rather the arrival of the suds at the high final

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suds level is an indication that the remaining steps in the washing process which consist of a succession of rinses, generally hot rinses followed by cold rinses, and generally a bluing and souring treatment with a bleaching treatment in addition may be carried through with the assurance that acceptably clean clothes will be produced at the end of the treatment without rewashing.

The high suds level is significant only near the end of any given period of agitation. At times, if the rate of soap feed is quite rapid, an appreciable amount of soap is present in the washer at the moment of feed shutoff that has not yet had a chance to combine with the water. It may then happen that there is a rise in the initial suds level above the initial suds level at the time of shutoff for a short period until this excess suds has combined with the soil. The significant indication is a high suds level persisting at the end of the period of agitation.

It has now been shown that an operating routine may be set up wherein the liquid level is always carried to the same elevation, a fixed quantity of clothes or fabrics introduced into the bath, the washer agitation started, a soap or detergent solution of known characteristics fed at a uniform rate until the suds reach the initial suds level. The soap supply is always shut off when this level is reached and the agitation continued for a fixed period. The dump valve is then opened allowing the dirty bath to escape to the drain. The dump valve is closed and the preceding procedure repeated. The agitation is thus continued in successive baths, each bath formed of the same quantity of water and having the same initial suds blanket, until the final suds reach the final suds level. The soap treatments are then discontinued and an established rinsing procedure is carried out.

The soil in the clothes is neither appraised before placing in the washer nor are the clothes examined during the procedure. With water level, suds levels, detergent type and concentration, and detergent rate of feed once properly established to deliver clothes that are clean according to any accepted standards of practice current in that laundry, each successive batch treated, regardless of the amount of initial soil present, will conform to that same standard.

The rise of the suds to initial and final suds level respectively may serve as a guide to the operator in the conduct of the washing process, the suds levels being observed through sight glasses.

In the preferred form illustrated in the drawing the arrival of the suds at each level is arranged to close electric circuits that light pilot lights.

While the process has been illustrated as manually conducted, the invention resides in the determination of when to stop feeding soap and when to stop the suds treatments to secure clean clothes at the end of the complete process regardless of whether performed automatically or manually.

The single figure is a schematic showing of a washing machine arranged to perform the novel process.

By referring to the drawing, it will be noted that the washing machine illustrated comprises a cylindrical receptacle 1 of conventional design, supported on saddles 2 and comprising end heads 3 and the cylindrical outer shell 4. This outer shell 4 has a door of conventional design, such as the door 5, arranged to slide on tracks 6.

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Within the washer shell, a washing cylinder 10 is supported on trunnions 11 mounted within the end heads 3 by means of suitable bearings provided therefor. This cylinder is made up of end plates 12 and a perforated cylinder wall 13 having a door 14 therein of any desired construction. The door may be of the sliding type mounted on tracks 15, or it could be pivoted or otherwise mounted. The cylinder 10 is adapted to contain the clothes or other articles to be cleaned or washed, which clothes or articles may be introduced through the doors 5 and 14 which come into alignment when the machine is at rest.

The machine may be driven by any type of power means, such as, for instance, by means of a power drive pulley 20 mounted on one end of the shaft 11 and over which passes one or more belts 21 which in turn may be driven by pulley 22 mounted on the end of the shaft of a reversing electric motor 23. The motor may be controlled through switches connected through panel 24, such as, for instance, the starting switch 26 and the stopping switch 27.

The washing machine is preferably equipped with means for introducing both hot and cold water, such as, for instance, the water line 30 which may be employed for introducing cold water and the water line 40 which may supply hot water. The cold water line 30 is equipped with a valve 31 biased by a spring or other suitable means to closed position and adapted to be opened by a hand lever 32. In the form of the invention here illustrated, when the hand lever 32 is raised a dog 33, which is pivoted thereon, may be caused to engage or lock over one of the teeth constituting a fixed stop 34 so as to hold the valve open to the desired degree. The pipe 40, provided for supplying hot water, is also equipped with a valve, such as that shown at 41, adapted to be opened by a hand lever 42 and, when opened, to be retained in open position by a dog 43 engaging one of the teeth of the fixed stop 44. This construction permits either one or both valves to be opened to the desired degree so that either or both hot and cold water can be admitted to the washing machine through the inlet feeding pipe 45.

The water may be shut off manually after the same has reached the desired level in the washing machine, or, as here illustrated, it may be shut off by means of mechanism which automatically shuts off the water when the same has reached a predetermined level. The mechanism for this purpose, here illustrated, comprises a well 50 connected to the washing receptacle by means of a pipe 51. A float is mounted in the well 50 connected to the stem 52 so that the float, which rises on the surface of the liquid, will cause the stem 52 to be elevated an amount indicative of the quantity of water in the washing machine. As shown in the drawing, stem 52 is provided with a pair of laterally extending lugs 54, each of which is positioned to engage one of the dogs 33, 43, respectively, so that when the float with its stem 52 reaches a predetermined height, the lugs 54 will operate the dogs 33, 43 and will free the valves so that they will automatically be moved to shut position, and in this way cut off the feeding of water.

The detergent or soap may be employed in either solid or liquid form, as may be desired in any particular case. In the illustration here given, it is preferred that the detergents be employed as liquids or solutions which may be contained in tanks 60, 61 and 62, respectively, which

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are in turn connected to the washing receptacle through pipes extending from the bottoms of each and controlled, respectively, by valves 63, 64 and 65.

The suds level responsive means here illustrated are electrical in character and comprise an electric circuit 70, which includes a transformer 71. Connected across the circuit 70 by suitable connecting wires is any suitable signalling or control mechanism 74 having a relay switch 72 connected in circuit therewith. Furthermore, a second signal or control mechanism 75 is connected across the circuit 70 by means of connecting wires which include a relay switch 73. The mechanisms 74 and 75 may be lights, noise-making devices, relays or any other desired mechanism which will operate when the switches 72 and 73, respectively, are closed and serve to give a signal to the operator, or to automatically control the operation of the mechanism as desired.

Connected to the opposite side of the transformer 71 is a circuit, one side 80 of which is grounded and the other side of which is connected through solenoids 82 and 83, respectively, to electrodes 84 and 85 mounted in the end head 3 of the washing machine. These electrodes are mounted, respectively, in insulating bushings 86 and 87 so that no current can flow into the solenoids 82 and 83 except when the corresponding electrode is short-circuited with the frame of the machine, such as by means of water within the washer.

The washing machine is also equipped with means for dumping the liquid contents, such as a dump valve 90 mounted in the bottom of the washing receptacle. This valve may be of a conventional design and equipped with an operating lever 91. The valve may be closed by forcing the same against its seat, and the same may be held shut by a dog 92 mounted on lever 91 which engages a portion of the frame. The dog is provided with a foot pedal part 94 used in operating the dog. To open the valve, the operator steps on the foot pedal 94, whereupon the dump valve moves to open position. Directly below the dump valve there should be suitable drain means 97 connected with the sewer or other outlet for disposing of the dirty waste liquids.

In the operation of the machine, the door 5 of the receptacle and the door 14 of the cylinder are opened and a batch of dry, dirty clothes or other articles to be washed are introduced into the interior of the washer. The doors are then closed and the starting switch 26 is moved so as to start the motor and, in turn, to start the cylinder of the washing machine in rotary motion. Water is promptly introduced into the washing machine and, according to the adjustment of the valves 31 and 41 relative to each other, the water will be fed in at the desired temperature. As the level of the water rises, it causes the float in the well 50 to rise and the stem 52 carried by the float to be elevated, with the result that when the water in the washing receptacle has reached the desired level, lugs 54, 54 will cause the dogs 33, 43 to be lifted in a manner to free the valve levers 32 and 42 so that the valves can automatically move to closed position. The effect of this operation is that the water shuts off, and the water in the washer is thus established at the desired level. Next, the operator adds soap according to the formula he may be using, either alone or in connection with alkali, by manipulating the measuring valves 63 and 64. These measuring valves

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are designed to add the soap solution at a fixed predetermined rate which is faster than the soap will be neutralized by the soil in the garments so that an initial suds can rise, and which nevertheless is slow enough so that the total quantity of soap may be measured by the length of time that the soap solution flows before the initial suds has reached its predetermined depth. This rate of flow once determined, may be held constant for any given machine and for given operating conditions regardless of the quantity of soil in the clothes. As these detergents are added to the water, a suds is formed, and this suds gradually rises until it reaches the level of the lower electrode 84. The result of the suds level reaching the elevation of the electrode 84 is that a short-circuit is created, and a circuit is closed which energizes the solenoid 82 which in turn causes the relay switch 72 to be closed. This action causes the device 14 to be energized, whereby a signal is given, or, if desired, the soap or detergent feeding mechanism is automatically shut off.

If manual operation is preferred, the operator, upon receiving the signal given forth by the device 14, will in response thereto promptly shut off the feed of detergent. After this is accomplished the washing is continued for a fixed period, based on predetermined standards of operation. The length of this continued operation is determined by the length of time required to get the maximum practical value out of the soap which has been added to the batch.

In accordance with this invention, it has been discovered that when the quantity of soap has been adjusted to the soil in the manner above described that a fixed period of subsequent agitation will, from the practical point of view, get the maximum value from the operation, regardless of what the absolute value may be of the amount of soil and the absolute value of the amount of soap. He next steps on the foot pedal 94 and thereby releases the dump valve and discharges the dirty water and soap into the drain well 97. The duration of the suds operation so conducted will be determined by a clock or other suitable timing means, or it can be conducted by means of clock mechanism which will automatically open the dump valve in the manner clearly understood in this art.

After the machine is dumped, if the clothes need further washing the dump valve is again closed and the above-described operation is repeated, with the same batch of clothes remaining in the washing machine.

If the operation is manually conducted, the operator will close the dump valve by stepping on the lever 91 and locking the same in closed position with the lever 94. Next, the operator introduces water through valves 31 and 41, as previously described. On this second suds operation, detergent is again added at the predetermined rate until such time as the indicating device 74 indicates that the detergent feed should be discontinued. A succession of such suds operations are thereupon conducted until such time as the clothes shall become "clean."

When the clothes approach a condition which has been selected, on the basis of predetermined standards as "clean," the detergent which has been admitted during the detergent feeding period will be excessive in quantity relative to the amount of soil present, and consequently such excessive amount of detergent will be productive of a suds level which continues to rise, as the washing operation is continued, above the nor-

mal suds level. This new suds level will be built up to a height which, when the clothes are sufficiently clean, will reach the elevation of the upper electrode 85. When this occurs, the solenoid 83 is energized, which in turn causes the relay switch 73 to be closed and the signalling or operating mechanism 75 to be energized. In the case of an automatic machine, the mechanism 75 would at this point cause the suds operation to be discontinued and the washing procedure to go on to a suitable rinsing treatment or treatments. When manually operated mechanism is employed, the mechanism 75 will indicate to the operator, by a suitable signal, that the washing is complete and he will thereupon discontinue the suds treatments and follow up with a suitable rinsing procedure. Any desired rinsing procedure is contemplated and may be employed to finish the washing procedure. Also, blue and sour treatments will be carried out in accordance with usual practice.

When the level of the contact 84 is properly adjusted in relation to the level of the upper contact 85 and the detergent feed mechanism, and depth of water employed, are all adjusted in proper relation to each other, it will be found that the machine works well in accordance with the principles of this invention and will function to indicate, or control the machine, when the clothes are "clean," so as to avoid further suds treatments.

By way of example, the following dimensions and washing conditions may be taken as one embodiment of this invention which is found to serve well in practice.

A washer of the horizontal type, like that shown in the drawing, was utilized, having a cylinder 42 inches in diameter and 84 inches long, and operating in a cylindrical receptacle slightly larger. The cylinder was adapted to revolve at a speed of approximately 22 R. P. M. by means of an electric motor which drove the washing cylinder several revolutions in one direction and then, by reversing the motor, drove the cylinder approximately the same number of revolutions in the opposite direction.

To this washer approximately 225 pounds of dry, soiled clothes were added and hot water was admitted until the water level was shut off at the desired height by means of the water level shut-off mechanism. When the proper water level was reached, detergent solution was introduced at the rate of $1\frac{1}{2}$ gallons per minute. This solution is made by mixing 175 pounds of soap and 175 pounds of meta-silicate with 700 gallons of water. At the same time, $\frac{1}{2}$ a gallon per minute of another detergent was added in the form of a solution which consists of 16 pounds of alkali dissolved in 50 gallons of water. The introduction of both of these detergents was started when the proper water level was reached, and both were shut off when the suds formed in the water reached the lower electrode 84. In this case, the lower electrode was placed from 4 to 5 inches above the water level. After shutting off the supply of soap and other detergents, the washing was continued for approximately 5 minutes, at the end of which time the dump valve was opened. In this case, the upper electrode was placed about 12 inches above the lower electrode 84.

The operation above described was repeated a number of times until such time as the clothes became "clean" and the suds level was caused to rise to the elevation of the upper electrode 85. When this upper level was reached by the suds

it was indicated by signal mechanism which told the operator that the clothes were "clean." In actual practice it was found that the clothes were clean as indicated by the signalling mechanism. In consequence, the suds operations were then discontinued and the procedure completed by conducting suitable rinsing treatments.

In the above mechanism, loads with varying degrees of soil as received in a typical commercial laundry were washed and, according to the amount of soil in each load, were given from 3 to 7 suds as the required number to properly "clean" the same before the indication as to the cleanness of the load was given.

When reference is made herein to "liquid level" or "suds level," it is to be understood that the level of the liquid as influenced by the presence of suds therein is referred to. It is known that when a cleaning liquid, such as water containing soap, is agitated air is whipped into the liquid and suds are formed, with the result that the volume of the liquid increases and the surface thereof is elevated. As additional water is not introduced to increase the volume of the liquid, it is apparent that the suds blanket associated with the liquid is increased in depth or thickness. It is the top of this blanket which is referred to as the suds level, although it is to be understood that there is no definite line of demarcation between the water and the suds, as there might be between the suds and water in a stationary tub.

The apparatus of this invention is not to be limited to the form illustrated in the drawing, as the novelty herein relates to the suds level control mechanism operable for giving a signal or other action such as that of setting into operation automatic control mechanism. In consequence, the invention is not to be limited by the foregoing disclosure, but is to be construed according to the terms of the appended claims.

What is claimed is:

1. The process of removing soil from fabrics which comprises agitating the fabrics in a series of successive baths, the quantity of water in each bath bearing a fixed relation to the quantity of fabrics; adding soap to each bath at the beginning of the agitation thereof at a fixed rate which is faster than the rate at which the soap can be neutralized by the soil present with the quantities of water and fabrics present until an initial blanket of suds is formed to a predetermined level; terminating the supply of soap when said blanket of suds is formed; continuing agitation until the entire period of agitation of each bath has lasted for a fixed length of time; the rate of soap feed being such that upon the termination of the soap feed there is present in the bath soap sufficient to produce a suds of at least a predetermined depth above the initial suds level when the end of the period of agitation is reached if the fabrics are clean at that time, but insufficient to produce such a depth of suds at that time if the fabrics are not clean; and stopping the series of baths at the end of the first period of agitation in which the suds is of at least said predetermined depth above the initial suds level at the end of the period.

2. The process of removing soil from fabrics which comprises agitating the fabrics in a series of successive baths, the quantity of water in each bath bearing a fixed relation to the quantity of fabrics; adding a solution of a suds forming detergent to each bath at the beginning of the agitation thereof at a fixed rate which is faster than the rate at which the detergent solution can

be neutralized by the soil present with the quantities of water and fabrics present until an initial blanket of suds is formed to a predetermined level; terminating the supply of detergent solution when said blanket of suds is formed; continuing agitation until the entire period of agitation of each bath has lasted for a fixed length of time; the rate of detergent solution feed being such that upon the termination of the detergent solution feed there is present in the bath detergent solution sufficient to produce a suds of at least a predetermined depth above the initial suds level when the end of the period of agitation is reached if the fabrics are clean at that time, but insufficient to produce such a depth of suds at that time if the fabrics are not clean; and stopping the series of baths at the end of the first period of agitation in which the suds is of at least said predetermined depth above the initial suds level at the end of the period.

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