United States Patent [19]

Rosenfeld et al.

[11] **3,780,543**

[45] **Dec. 25, 1973**

[54] **LAUNDERING SYSTEM WITH SOAK OF GARMENTS ON HANGERS**

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[73] Assignees: **A-T-O Inc.,** Willoughby, Ohio; **American Linen Supply Co.,** Minneapolis, Minn. ; part interest to each

[22] Filed: **Mar. 13, 1972**

[21] Appl. No.: **234,096**

Related U.S. Application Data

[62] Division of Ser. No. 55,468, July 16, 1970, Pat. No. 3,686,899.

[52] **U.S. Cl.** ..... **68/18 F**

[51] **Int. Cl.** **D06f 31/00,** D06f 39/10

[58] **Field of Search** ..... 68/3 R, 10, 62, 205 R, 68/18 F; 8/150

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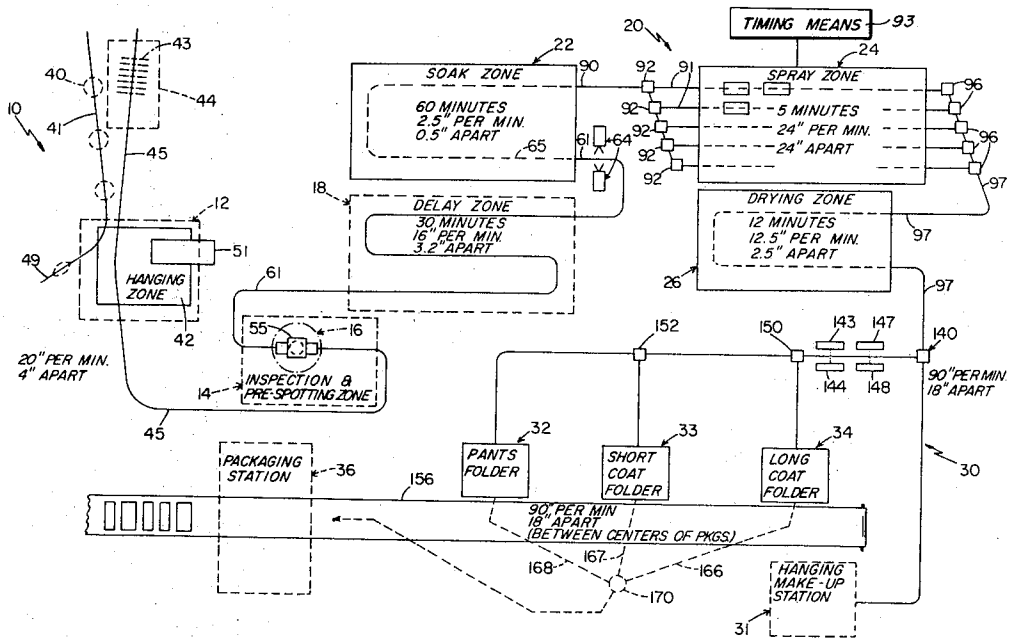
Primary Examiner—Harvey C. Hornsby
Assistant Examiner—Philip R. Coe
Attorney—John Noel Williams

[57] **ABSTRACT**

A laundering and finishing system for garments (such as no-iron garments) collected from a number of user sources of soiled garments includes a hanging zone, a washing zone including spray assemblies, a drying zone, and a conveyor network extending from the hanging station through the washing and drying zones, the conveyor network being adapted to support individual garments on hangers to hang loosely for washing and wrinkle-free drying in the zones, the hanging zone being arranged to enable a worker to hang soiled garments from one user source at a time in serial order upon an initial conveyor of the conveyor network, and the conveyor network being further adapted to discharge the garments in the same serial order so that garments originating from different sources of soiled garments are not mixed. Preceding the washing zone a soak zone is provided including means to guide garments on hangers therethrough.

8 Claims, 12 Drawing Figures



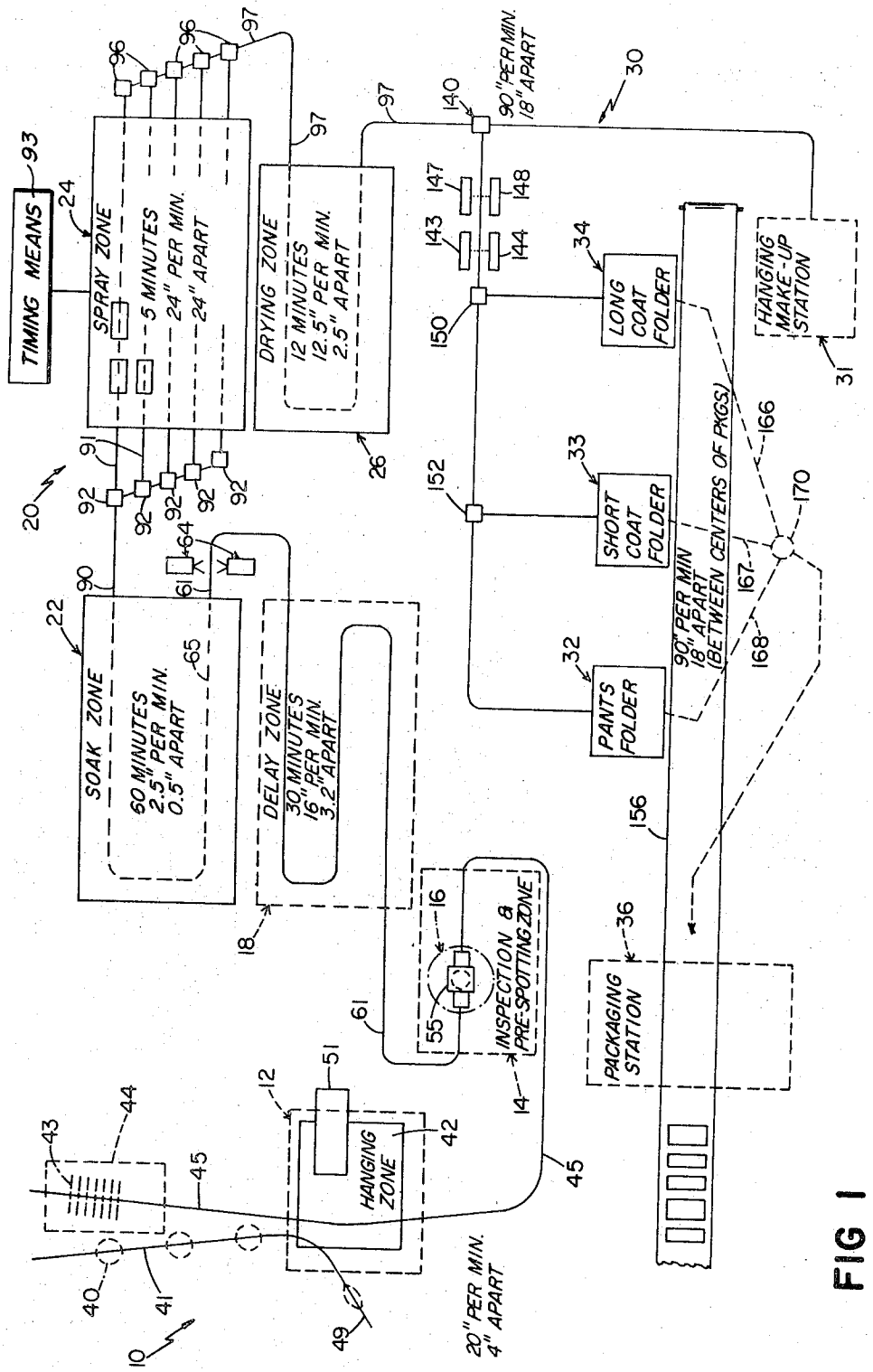

TIMING MEANS
93
SPRAY ZONE
5 MINUTES
24" PER MIN.
24" APART
DRYING ZONE
12 MINUTES
12.5" PER MIN.
2.5" APART
SOAK ZONE
60 MINUTES
2.5" PER MIN.
0.5" APART
DELAY ZONE
30 MINUTES
16" PER MIN.
3.2" APART
INSPECTION & PRE-SPOTTING ZONE
HANGING ZONE
LONG COAT FOLDER
SHORT COAT FOLDER
PANTS FOLDER
HANGING MAKE-UP STATION
PACKAGING STATION
90" PER MIN.
18" APART
90" PER MIN
18" APART
(BETWEEN CENTERS OF PKGS)
20" PER MIN.
4" APART

FIG 1

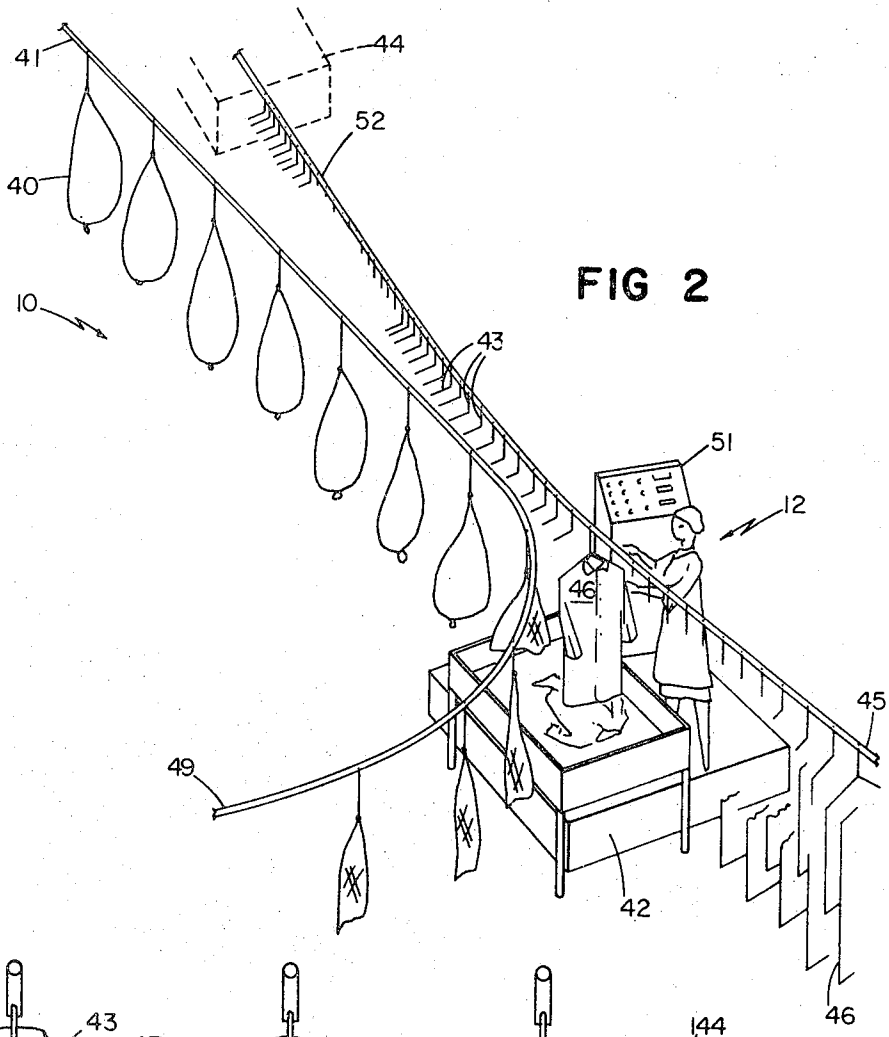

41
44
52
40
10
43
51
12
46
45
49
42
46

FIG 2

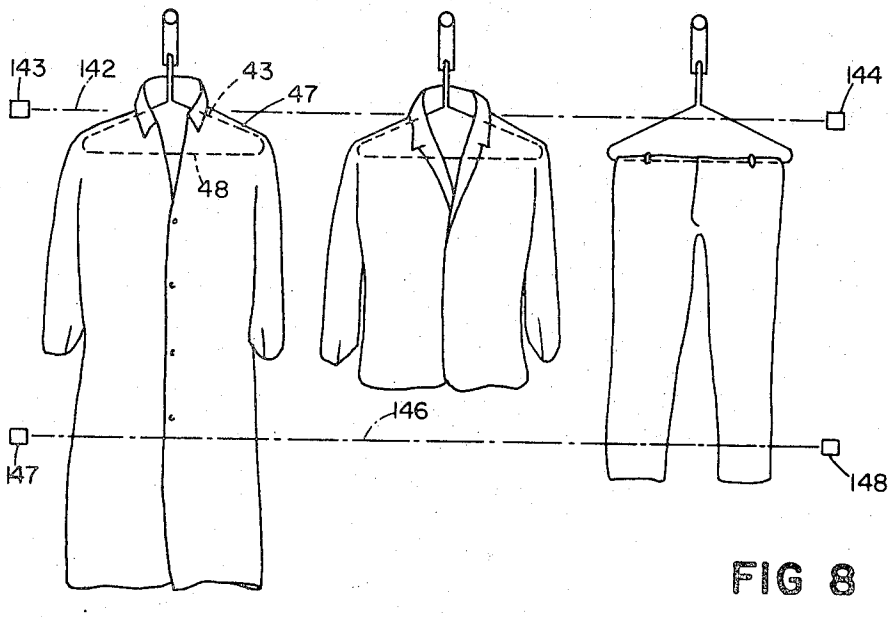
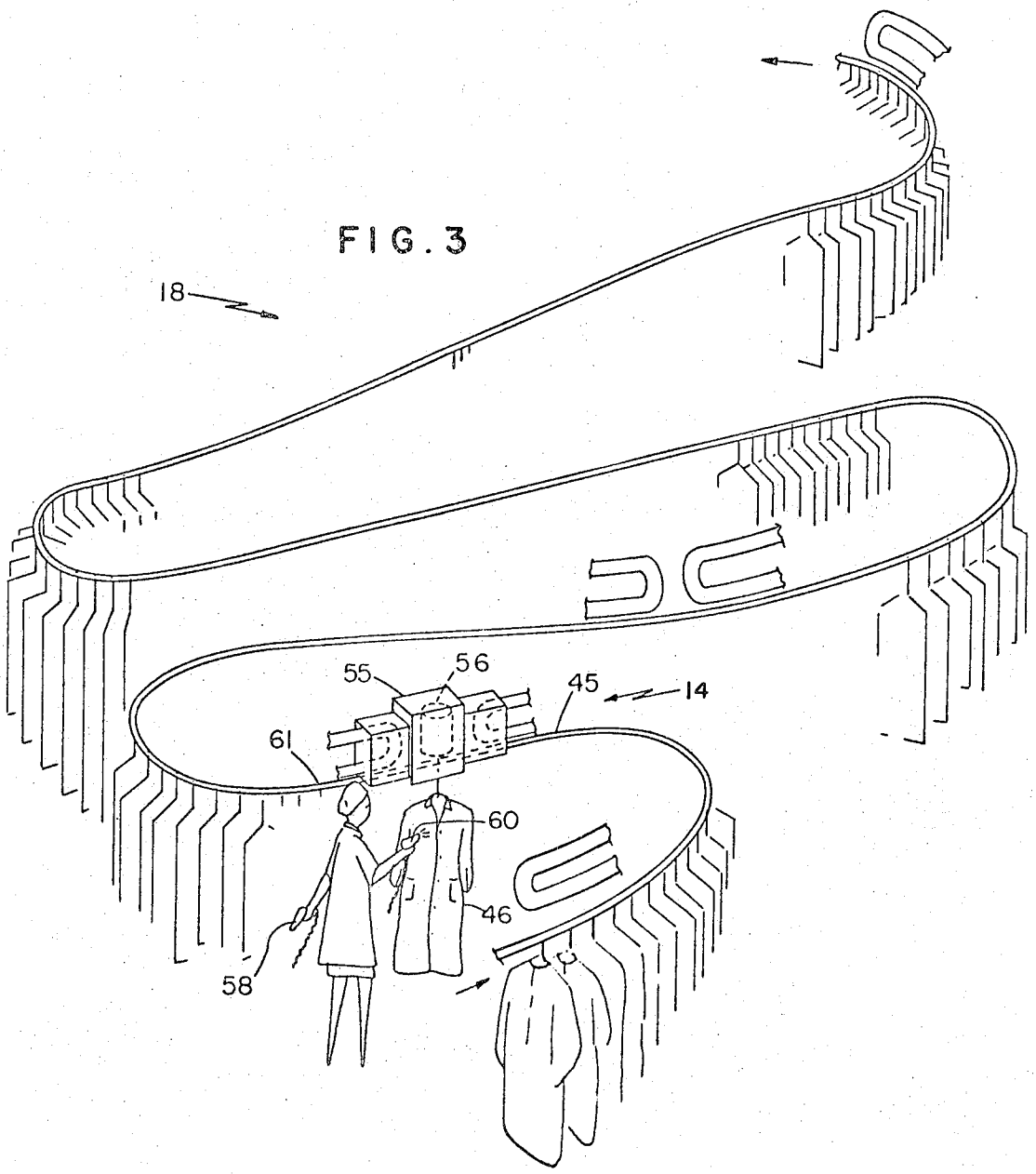

143
142
43
47
144
48
146
147
148

FIG 8

FIG. 3



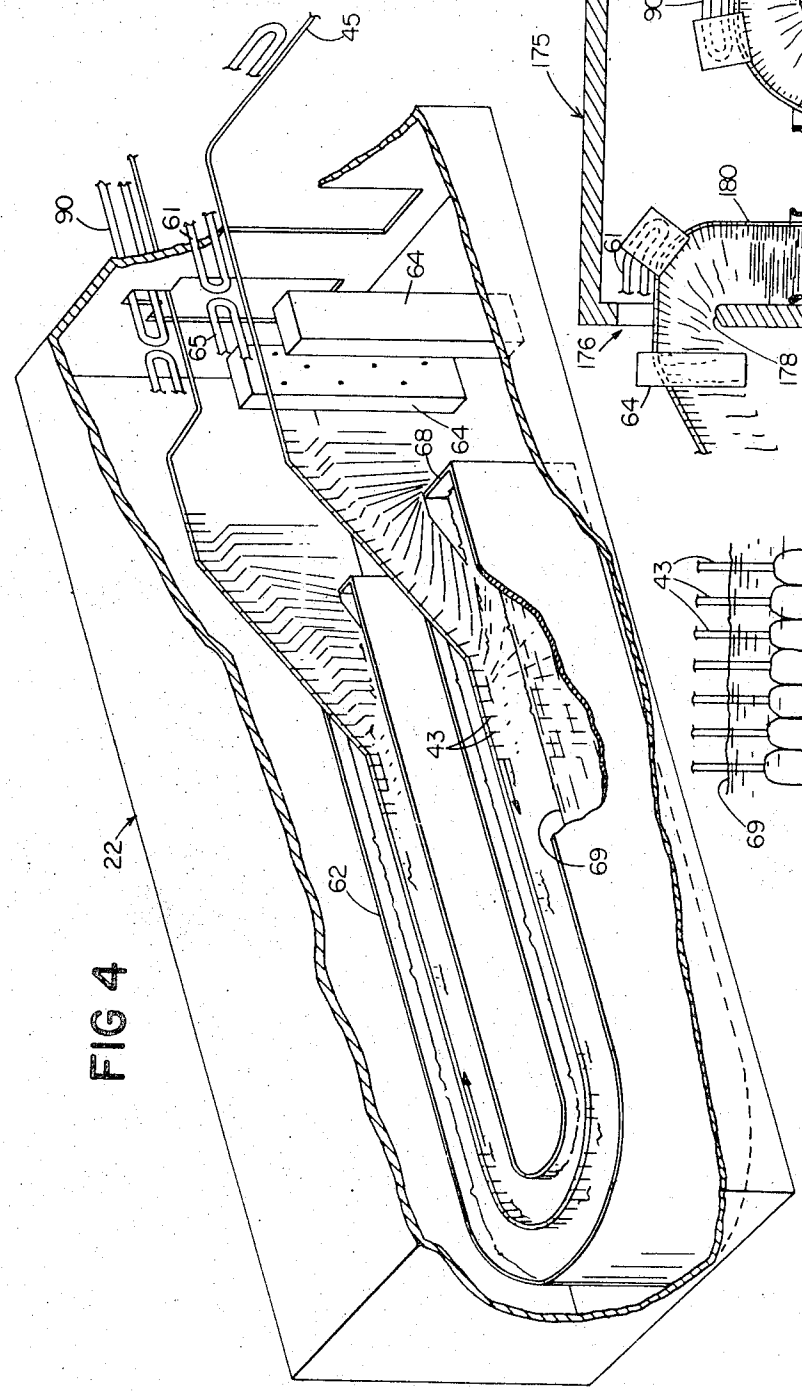


FIG 4

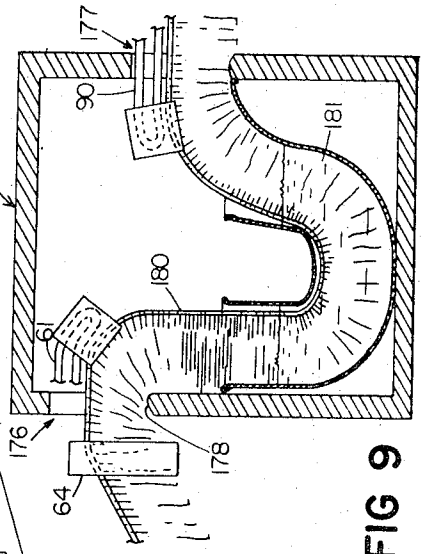


FIG 9

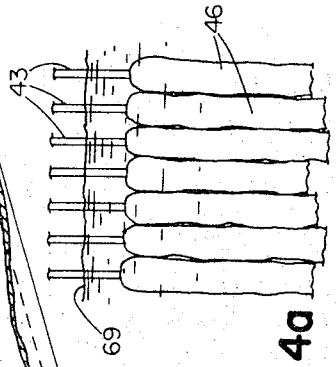


FIG 4a

FIG 5

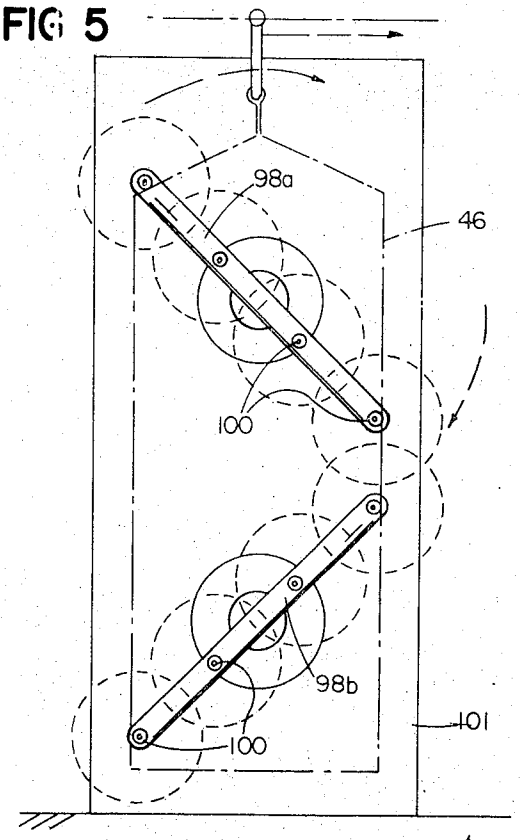


FIG 6

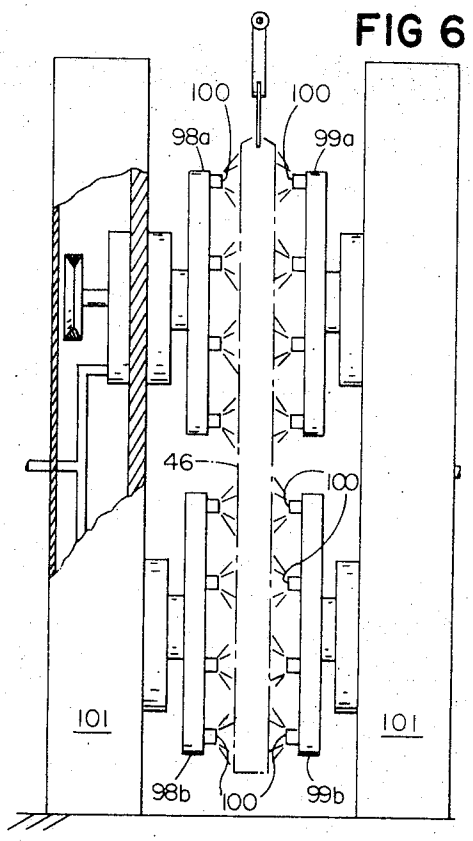
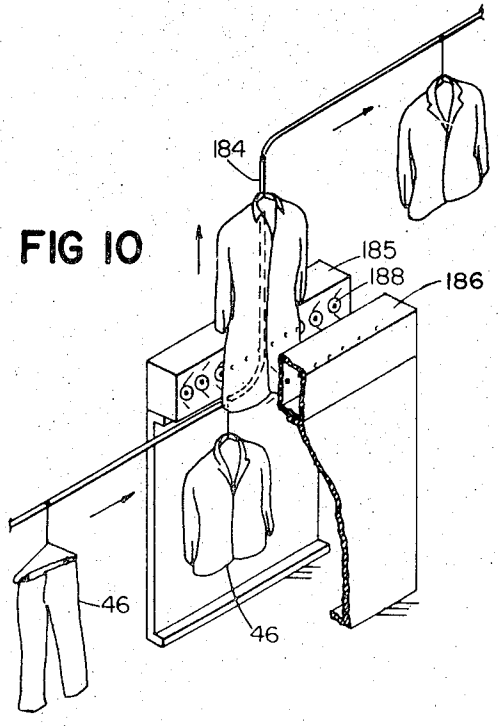


FIG 10



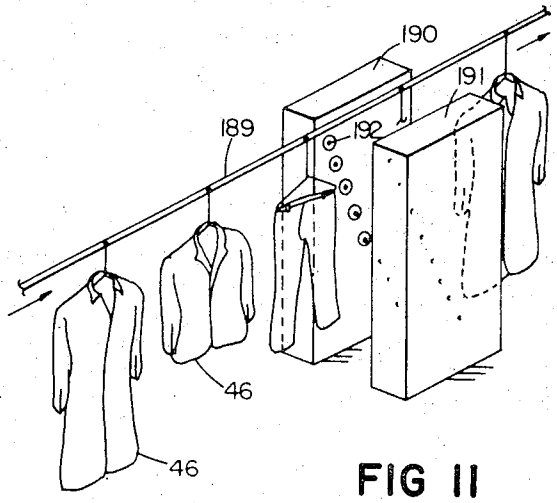
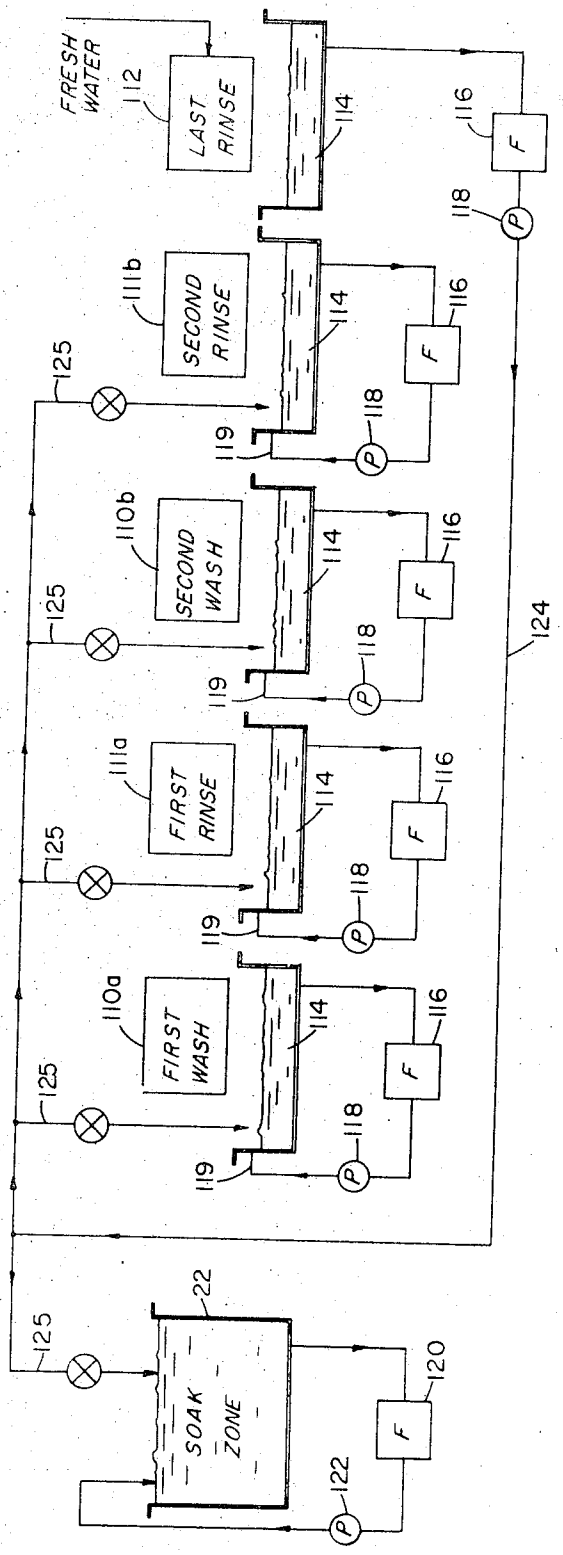


FIG 11

FIG 7


FRESH WATER
112
LAST RINSE
114
116
F
118
P
111b
SECOND RINSE
125
119
110b
SECOND WASH
124
111a
FIRST RINSE
110a
FIRST WASH
22
SOAK ZONE
120
122

LAUNDERING SYSTEM WITH SOAK OF GARMENTS ON HANGERS

This is a divisional application from U. S. application Ser. No. 55,468 entitled Laundering System filed by the present inventors on July 16, 1970, now U.S. Pat. No. 3,686,899.

This invention relates to commercial laundering and finishing systems for rental garments and the like.

An object of this invention is to provide an improved and automated laundering and finishing system for processing garments and the like in an orderly manner.

Another object is to provide commercial laundering systems with reduced solids and water usage and hence very low pollutant discharge levels.

Among other objects are to provide commercial laundering systems which: have improved garment cleaning; process "heavy" and "light" soil, colored and white, and differently configured garments together; handles, launders and finishes "no-iron" garments without pressing; can provide sanitary, and even sterile, sealed package garments and lint-free sealed package garments; reduce water and detergent-consumption; reduce man-hour requirements (while improving working conditions); and, reduce garment abuse such as fiber wear; and, simplify customer "make up" for delivery.

A specific object is to provide a commercial laundering system which is fully automated between receipt of soiled garments from a customer and production of clean, ready to wear garments for delivery back to the customer.

The invention features a laundering and finishing system for garments (such as no-iron garments) collected from a number of user sources of soiled garments comprising, in combination, a hanging zone, a washing zone, a drying zone, and a conveyor network extending from the hanging station through the washing and drying zones; the conveyor network is adapted to support individual garments on hangers to hang loosely for washing and wrinkle-free drying in the zones, the hanging zone is arranged to enable a worker to hang soiled garments from one user source at a time in serial order upon an initial conveyor of the conveyor network, and the conveyor network is further adapted to discharge the garments in the same serial order so that garments originating from different sources of soiled garments are not mixed. The system thereby enables rapid automatic processing including washing, drying, and packaging of the garments, such as rental garments, with the serial order of the garments maintained throughout the system, the time required for processing each garment significantly reduced, and the garments provided in finished form of fully pressed ready-to-wear appearance.

A preferred laundering system comprises, successively arranged, a hanging zone, an inspection and pre-spotting zone, a soak zone, and a spray zone, all preceding the drying zone. At the pre-spotting zone, spot-loosening solution is applied to the garments. The pre-spotting zone and the soak tank are preferably separated by a delaying zone wherein the spot-loosening solution is allowed to act upon the spots. The garments are preferably introduced into a preferred soak tank arrangement in the soak zone with their broad sides butted together to prevent garments from floating to the surface of the soak tank, and are completely immersed in the soak tank. The garments are also preferably pre-wetted, prior to entering the soak tank, either by water or by a detergent-water solution so that the weight of succeeding garments assists in forcing preceding garments down into the soak tank. The conveyor system may continue through the soak tank, thus forcing the garments forward at a predetermined rate through the soak tank while the garments remain immersed. In one alternative embodiment, the soak tank is in the form of a J with arriving garments being supplied to the top of the high side of the tank and the weight of garments, including the added weight of arriving garments, serving to force-soak garments around the curve of the tank and eventually out through the low side of the tank. For conveying the garments through the J-shaped tank, the guide means may simply be a slick rail upon which the hangers can slide as the garments progress through the tank In another embodiment, a low pressure spray environment is used in lieu of the soak tank, as the soak zone.

The garments are generally conveyed through these zones arranged on hangers oriented with the long directions of the hangers at right angles to the conveyor line. In a preferred spray zone, however, the garments are turned so that the long direction of the hangers is aligned with the direction of the conveyor. This spray zone has water spray assemblies positioned along the broad sides of the garments. These water spray assemblies are arranged successively along the path of travel of the garment to define a plurality of spray stations of which the last spray station is a fresh water rinse, and the remaining spray stations include alternating wash and rinse stations and, if desired, additional stations such as for bleaching and for applying bacteria-destroying solutions. The water spray assemblies are preferably arranged so as to provide relative movement between these assemblies and the garments during washing. For example, the water spray assemblies may be moveable relative to a stationary garment, such as one or more spray lines mounted to rotate in a plane generally parallel to the plane of the garment. The garment may be kept stationary at each station, as by timing means in a conveyor system extending to the washing station which stops each garment adjacent a water spray assembly for predetermined spraying time. Alternatively, the garment may also be mounted for moving, vertically relative to spray assemblies.

The spray assemblies arranged on opposite broad sides of the garment are preferably arranged to oppose one another sufficient to prevent force-through of dirt, loosened in a soaking zone upstream of the spray zone, and yet still provide some relative movement or fluffing of the garment.

In a preferred embodiment, there are a plurality of multiple parallel conveyors through the spray zone with a plurality of parallel spray stations arranged along each conveyor, a single conveyor line feeds the garments to a divider and hence serially into the multiple conveyor zone, and a merger device following this spray zone merges the garments again onto a single conveyor line in identical serial order to that preceding the spraying zone. A single soak tank precedes and serves all parallel spray stations.

The invention further features a pollution-reducing commercial laundering system in which a soak zone and a washing zone, through which garments are conveyed on hangers, each has a recycle stage which is adapted to collect the used liquids, regenerate wash

and rinse liquids therefrom by filtering, heating, adding chemicals, etc., and return the water for soaking, washing, or rinsing. The washing zone further includes a last rinse station which is adapted to receive fresh water and to collect used water from that last rinse station to be directed on demand to the soaking zone, the wash stations, or the rinse stations. The soaking zone is also, as are all systems, continually recirculated, and, at a rate of processing **300** garments per hour, need be drained and the water changed only about once a week. The efficiency of this laundering system further allows less detergents, soaps, and other non-degradable materials to be used as well as decreasing the total amount of polluted water discharge.

Other objects, features and advantages will be apparent to one skilled in the art from the following description of preferred embodiments of the invention, taken together with the attached drawings thereof, in which:

FIG. **1** is a layout drawing of a garment processing system embodying the present invention;

FIG. **2** is a schematic illustration of check-in and hanging zones;

FIG. **3** is a schematic illustration of an inspection zone;

FIG. **4** is a diagrammatic perspective illustration of a soak tank;

FIG. **4A** is a cut-a-way view of a section of the soak tank of FIG. **4** showing garments butted together and hence maintained fully immersed beneath the soak fluids in the tank;

FIG. **5** is an elevational view of a sprayer section arrangement for the stations of the spray zone;

FIG. **6** is a sectional view of the sprayer of FIG. **5**;

FIG. **7** is a water recirculation diagram for the spray zone;

FIG. **8** is a schematic view of a photoelectric arrangement for guiding garments to the correct folding station;

FIG. **9** is a diagrammatic cross-sectional illustration of another soak tank; and,

FIGS. **10** and **11** are other sprayer station arrangements.

The figures show a garment handling system **10** comprising a hanging or check-in zone **12,** an inspection zone **14** including a pre-spotting station **16,** a delay zone **18,** a laundering zone **20** consisting of a soak zone **22** and a spray zone **24,** a drying zone **26,** and a discharge zone **30** including a hanging make-up station **31,** or, optionally folding stations **32, 33, 34,** and a packing station **36.** For purposes of illustration, a commercial laundering system will be described, designed to launder rental garments at a rate of about **300** garments per hour.

Referring to FIGS. **1** and **2,** at the hanging or check-in station **12,** individual customer bundles **40,** filled with soiled garments, are conveyed to the check-in station by a bag conveyor **41,** and are released by the check-in worker, one of three workers required, onto a work table **42.** Disposable hangers **43** are fed to the hanging station from a hanger magazine **44** the hangers being mounted firmly and substantially immobile on a hanger carrier **52** driven by a conveyor **45.** A single hanger design may be used for all types of garments—shirts, pants, dresses, trousers or coats. The hangers may be of disposable material (e.g., fine coated wire or cardboard).

Garments **46** worn on the shoulders are hung over the top bar **47** of the hanger, whereas trousers are hung from the bottom bar **48.** The garments are fed, at a rate of 20 inches per minute, spaced 4 inches apart as indicated (hanger to hanger) on the conveyor **45.** Thus, in the few seconds required to hang the garment, the hanger is moving only slightly, and the total rate of 12 seconds per garment, or 300 garments per hour requires only one worker at this station. The conveyor **45,** shown as a double rope conveyor, may be of any design—e.g., also a screw conveyor, or a chain conveyor. The depleted customer bundle bags are led away on conveyor **49.**

The illustrated hanging station is also a counting station and the operator, in addition to hanging garments, will identify customer number and e.g., "flag" the first and last garment of each customer in a manner which can be later "read out" at the make-up zones. In addition, information may be fed into a console **51** such as the type of garment, its color, or its soil level (e.g., to identify garments unusually heavily soiled). The garment, once hung, is now permanently sequenced, which sequence will continue throughout the system.

As observed, this system takes advantage of soiled garment customer pre-sort and maintains segregation by customer throughout the process. The continuous, steady flow makes possible the direct labor savings of this system over conventional bath systems, "washing-on-a-hanger" being the key to continuous flow and to maintenance of customer segregation.

The garments, on conveyor **45,** still at 20 inches per minute and 4 inches separation, are conveyed to the inspection zone **14,** shown in FIG. **3,** and delivered singly to a turning mechanism including a motor **56,** where the garment makes one or more complete turns in front of the inspector in a total elapsed time of 12 seconds so that the entire surface of the garment is visible. In lieu of motor **56,** the garment could be gravity fed down a helical screw or "pig's tail" to cause this turning. The inspector, the second worker in the system, pre-spots bad stains (i.e., by spraying with an appropriate stain-loosening examining while examing the garment. The collars of all garments, as well as the sides of garments, such as laboratory coats, and the areas around coat and pants pockets may be automatically pre-spotted, either before or after the visual inspection zone. The inspector has a number of "guns" suspended from above, including a suction gun **58** for removing foreign matter from pockets, and a spotting gun **60** for pre-spotting particularly difficult stains such as blood and grease.

The inspector also identifies garments in need of repair (tears, buttons missing) and tags the garment (e.g., by pulling down a tab on the hanger, or marking a colored spot on the hanger) or the disposable hanger carrying the garment for subsequent diversion to a repair station at the end of the line. The garment will not be removed from the line, however. Likewise, if the garment is to be replaced, another signal will be placed on the hanger. This replacement and/or repair will occur in the make-up zone after the laundering cycle is complete.

Since 6 to 10 seconds will be ample for this operation, one inspector can easily handle the 300 garments per hour anticipated of the check-in operator.

The hanger is passed out of the zone on conveyor **61,** where the spacing between the garments is reduced to

3.2 inches in the illustrated embodiment, and the speed of conveyor **61** through the delay zone **18** is also reduced to 16 inches per minute in the illustrated embodiment. In the illustrated system, a cycle time of thirty minutes, which is a desireable "setting time" for the solvents or other cleaning agents applied at the pre-spotting station, is required to transport the garments between the inspection station and the soak tank. In general, about 15–45 minutes should elapse between pre-spotting and the soak tank to achieve maximum benefit from the applied solvent.

Conveyor **61** delivers the garments to the soak zone **22** of laundering zone **20,** shown in FIG. **4,** which, in the illustrated embodiment, comprises a soak tank **62** in the soak zone, the dirt is loosened but not removed, since there is no mechanical action in the soak tank, except for a slow drain into a filter system, which removes the heaviest dirt which actually comes off during soaking, and, a concurrent slow make up of water. Any bleeding of color or loosening of dirt from the fabric is filtered or chemically removed through the continuous filtration and recycling system, shown schematically in FIG. **7.** Because of the absence of mechanical action in the soak tank, the soak time, temperature, and detergents for the tank may be chosen in accordance with the worst soiled garments, and hence heavy and light soil garments treated together, since excessive soaking conditions will do no harm to the light soil. The speed of the soak tank can then be kept constant irrespective of the soil condition of the garments.

Referring particularly to FIG. **4,** the garments **46** are pre-wet by sprayers **64,** which may apply either water, or a soap or detergent solution to the garments prior to their entering the soak tank. Conveyor **61** delivers the wetted garments **46** to conveyor **65,** which passes the garments, in butting relation, over a lip **68** into and through the tank. The prewetting prevents air bubbles and "air bombing" and thus retards the tendency of the garments to float to the surface. The weight of succeeding pre-wetted garments causes each garment to be immersed in the soak tank. In addition, since the spacing between the garments in the tank is reduced to about one-half inch between hangers, the garments, abutting one another, and the entire conveyor system also, if desired, remain immersed in the soak fluid **69** in the soak tank. A useful soaking time for garments in this tank is on the order of 60 minutes. Thus, in a system processing 300 garments per hour, an exemplary soak tank, utilizing a U-type garment pass therethrough as shown, would convey garments, at one-half inch spacing, at a rate of about 2 ½ inches per minute, along a total conveyor path through the tank of about 12.5 feet.

The detergents and soaps utilized in the soak zone are conventional, and a temperature of about 160°–195°F is preferred. It most of the garments are colored, one may lower the temperature down to 140°F and increase the time in the tank (in which event a larger tank will maintain the speed at the worker stations and hence the garment/hour output of the system).

The garments, with dirt loosened but not yet totally removed, are conveyed out of soak zone **22** on conveyor **90** and before the spray zone **24** they are separated into a plurality of parallel lanes **91** (FIG. **1**) preserving serial order and then rotated. Since the garments have been turned 90°, they are now arranged in a shoulder-to-shoulder relation, so that, instead of travelling perpendicular to the conveyor, they are now parallel to the conveyor. The spacing is increased to almost 24 inches between hangers.

The avoidance of dirt "force-through" is most important with polyester and other manmade fibers, since such force-through entrainment could result in redeposit of dirt due to the affinity of most resins for attracting and holding dirt. In, for example, prior conventional wash wheels, the mechanical action in the wheel removes the dirt from the fabric, and the dirt goes into suspension in the liquid of the wash wheel as fine particles. In the rinse cycle, however, which is also in the wash wheels, this dirt is forced back through the garment, thus causing the garment to act as a filter--unfortunately, if the garment is a polyester or other resin, or if it contains "permanent-press" resins, the garment will be a very good filter, trapping and holding the fine dirt particles that were originally removed. This accumulative action can result in the buildup of this re-deposit, causing white fabrics to turn gradually gray and neutralizing the color of colored fabrics. The spray zone of the present system however, reduces this accumulation by not pushing dirt through the fibers, but merely rinsing what has been previously loosened and surfaced in the soak zone.

The spray pressure from each nozzle should therefore be low enough to prevent fiber abuse and destruction (such as breakdown of fiber blends)(particularly at the bleaching station, if one) and yet sufficient to provide adequate loosened dirt removal. Line pressures on the order of 20 to 40 p.s.i. may be sufficient, and nozzle separations of about 2 to 3 inches from the garment.

Rotating rods as described have the further advantage that they provide fluffing and agitation of the garment, moving sleeves and the like out of the way so that the spray gets, e.g., underneath the sleeve, and the entire garment is thus exposed.

For processing 300 garments per hour, in a five spray station device as shown, the total time for each garment in the spray will be about 5 minutes, or 60 seconds per garment per spray station. Thus, the five spray lines will each discharge one garment per minute, for a total five garments per minute discharge from the spray zone. Since the garments have been rotated 90° prior to entering the spray zone, the spacing is now 24 inches, and hence total conveyor speed through the zone is 24 inches/minute, operated, by appropriate timing means **93,** as a series of fast steps (e.g., 5 seconds) between spray stations and stops (55 seconds) at each of the spray stations. Shutters or other structures may be provided not only between adjacent lanes (cf. shutters **101** in FIG. **6**) but also between adjacent spray stations so that the detergent spray will not mix with the rinse spray, the rinse spray will not mix with the bleach spray, etc.

The number of stations provided in each lane depends on the washing procedure desired, and, since total garment throughput depends only on time per station, the number of stations does not affect the total speed of the system. An illustrative, **8** station spraying zone might duplicate the conventional wash wheel, having, as successively arranged stations, a detergent (or soap) spray, a rinse, another detergent or soap spray, a rinse, optionally a bleach and a rinse, a sour, and, last, a clean rinse. All the rinse phases would be water. The sour phase neutralizes the bleach and stabi-

lizes the chemical exposure of the fabric. For colored garments, the fifth or bleach station could be selectively operated in accordance with the color of the garment, e.g., by a color discriminator located at each station or by a pre-coded signal on the garment or hanger read out at the bleach station.

Each spray section, as well as the soak tank is continually recirculated and filtered. During the recirculation cycle, additionally, the temperature and chemical constitution of the recirculation liquids are monitored, and heating or chemical additives applied as need. In addition to reducing the possibility of re-deposit, the purification and reuse of soak and spray liquids is extremely economical and reduces the possibility of discharge of large quantities of polluted effluents from the system. Only the last rinse, pure water, would not be recirculated rinse, but this last rinse may be utilized as make-up water in the soak tank and, as required, also in the spray zones.

In FIG. **7**, a recirculation system for an exemplary five-station system is schematically illustrated. In particular, each wash and rinse station **110***a*, **110***b*, **111***a*, **111***b*, **112** is conceived to have a flui container **114**, from which fluid is slowly drained, passed through an appropriate filter **116**, and pumped through a recirculating conduit by pump **118**. For both wash stations **110***a*, **111***a*, and the two rinse stations **110***b*, **111***b*, the recirculating conduit **119** leads back to the fluid supply. Similarly, for soak zone **22**, a filter **120** and pump **122** continually recirculate soak zone fluids. Last rinse station **112**, however, is continually supplied with fresh water to its fluid supply, and filtered fluid from this last rinse station is fed through a make-up conduit **124** back to replenish the soak tank, wash stations and other rinse stations through make-up supply lines **125**. The soak zone, as previously described, is periodically at least partially drained, and, if desired, wash or rinse station fluids may be used also for soak tank make-up, the wash and rinse stations then being made up from the last rinse zone or fresh water.

As shown in FIG. **1**, garments are fed sequentially at divider junctions **92** to one of the five (or more) conveyors (e.g., each five consecutively arranged garments on conveyor **90** will be fed one to each conveyor) defining lanes **91**, and are again merged at merging junctions **96** after completion of the spray zone cycle onto conveyor **97**. The five (or more) conveyor lanes **91** thus do not cause sequence to be broken, but do allow reasonable pass-through times for garments in the spray zone.

In the spray zone, the garments are sprayed to remove dirt previously loosened in the soak zone. One suitable sprayer system is shown in FIGS. **5** and **6**, which may be duplicated for each station in each lane. Two rotating rods **98***a*, **98***b* and **99***a*, **99***b*, each having four spaced nozzles **100**, are located on each side of the garment, and are sized so as to cover the complete area. Each nozzle may be either straight or pulsating and all nozzles are sized to deliver overlapping spayrs so as to cover completely the exposed garment surfaces. The nozzles on opposed rods **98***a*, **99***a* are generally arranged to provide opposing sprays, since, in general opposition, or near opposition, tends to prevent spray from the nozzles from forcing dirt through and onto the garment where it could become entrained. The more perfect the opposition of the nozzles on opposite sides of the garment, the higher the spray pressures which can be used. However, it is also desireable that the sprays be slightly offset to provide motion of various portions of the garment. Furthermore, the nozzles are preferably oriented to spray at an angle to the garment (preferably, 30° to 40° to the horizontal), better to remove loosened dirt without forcing it back into the garments.

The garments, on conveyor **97**, dripping wet from the spray zone, then proceed to the drying zone **26**, which may be simply a hot air tunnel.

From conveyor **97** now at 90 inches per minute, and at 18 inch separation, the dried garments are fed to junction **140**, which either sends the garments to a folding station or to a hanging make-up station **31**, depending on customer preference. Each garment, or merely the first and last garment of each customer, may have a simple either-or signal, applied, e.g., to the hanger at the hanging station, and now read out by appropriate means of junction **140**. Or, junction **140** may be operated from console **51**, by reason of the serial order of the garments, by utilizing a counting device to determine which direction each garment is to take.

If the garments are to be delivered folded, the appropriate folding station for the particular garment type (long coats and dresses, short coats, shirts and smocks, or pants) may be determined by means of a coded signal on the hanger or conveyor or, as shown in FIGS. **1** and **8**, by means of a simple photoelectric detecting system. As there shown, beam **142** between a photo-optic beam or light source **143** and a photocell-type sensor **144** is arranged at hanger level and beam **146** between a photo-optic beam or light source **147** and a photocell-type sensor **148** is arranged below short coat (shirt) level and above long coat (laboratory coat) level. When both beams are interrupted, a signal will be produced which will open gate **150** to lead the garment to the long coat folder **34**. If beam **142** only is interrupted, a different signal will be produced to open gate **152** but not gate **150**, so as to admit the garments to the short coat fold station **33**. When only beam **146** is interrupted, neither gate **150** nor gate **152** will open, allowing trousers to pass to pants folder **32**.

Thus, customer segregation, and serial order at the other end of the folding machines will be maintained because of the equal path lengths and total garment travel time between junction **140** and conveyor belt **156** through the folding machines, the excess machine capacity, and the approximately equal machine speed. However, serial order may also, or alternatively (if the machines are slower) be maintained by precoding numbers onto the hangers, and feeding folded garments along routes **166, 167, 168**, shown in FIG. **1** in dotted outline, thus initially by-passing conveyor **156**, to a readout merger gate **170** which will select garments from a route **166, 167** or **168** according to the serial numbers of the garments, and then feed the garments in serial order onto conveyor **156**.

Folded garments are merged onto conveyor belt **156** are fed into a conventional plastic bag packaging machine **36** for packaging of individual garments, in serial order.

The "washing-on-a-hanger" system allows for substantial variation in the construction of each particular zone, without departing from the spirit of the invention. For example, in the hanging zone, instead of conveying garments past the check-in worker, a mechanism can be employed to hold the hanger in a set position while

the operator is hanging the garment, which will release when the garment is on the hanger by virtue of the weight of the garment.

In the soak zone, in lieu of the conveyored soak tank **62** of FIG. **4**, there is shown in FIG. **9** an alternate tank in the form of a J-tank **175** having a high entrance side **176** and a low exit side **177.** The garments are fed over a lip **178,** which may be similar to lip **68** of soak tank **62,** and are pre-wetted by sprayers **64.** In lieu of the conveyor of tank **62,** a slick rail **180** extends through J-tank, for receiving tha hangers from conveyor **61** and supporting the hangers in tank **175.** The weight of arriving garments at entrance side **176** forces the previous garments vertically down, through the soak fluids **181** and out the exit side **177,** where the hangers are passed to conveyor **90.** The same garment rate as described for soak tank **22** may be maintained through J-tank **175.**

It is also conceived that, in lieu of soak tanks **62** or **175,** a spray zone could be used in which a soft, rain-like spray of continuously recirculated soak liquids, in a confined chamber, gently soaks garments passing slowly therethrough to loosen dirt.

In the spray zone, in lieu of or in combination with the rotating spray rods shown in FIGS. **5** and **6,** other arrangements, some of which are schematically illustrated in FIGS. **10** and **11,** may be employed. FIG. **10** shows a vertical conveyor means **184,** for moving garments slowly up between fixed spray assemblies **185, 186,** each of which has a plurality of nozzles **188** arranged, as are the nozzles **100** of FIGS. **5** and **6,** substantially in opposition to prevent dirt force-through but somewhat offset to allow for relative garment movement. It may be preferable to have nozzles **188** generally pointing down at an angle, although in some cases (e.g., to get under sleeves) some or all of the nozzles might point at an upward angle. In FIG. **11,** the garments are moved slowly on horizontal conveyor **189** between fixed spray assemblies **190, 191,** arranged transverse (or vertically) to the direction of garment travel and, as with assemblies **815, 186,** arranged to completely cover the exposed garment area, with nozzle **192** arranged similarly to nozzles **188.**

In another variation the rods **98***a*, **98***b* shown in FIG. **5** could be arranged for rotation not as shown but about their longitudinal axes in a 90° arc in each direction away from the plane of the garment. The rods would be arranged parallel to each other, and along the direction of garment travel and rods on opposite sides of the garment and the nozzles thereon arranged to provide substantially opposed, but also somewhat offset sprays. In other variations it is conceived that spray assemblies, such as rods **98***a*, **98***b*, could be arranged, in lieu of rotating, to move up and down, or back and forth across the garment. Or, in lieu of the illustrated spray rods, lawn-sprinkler type sprayers could be used.

This laundering and finishing system offers a number of advantages over previous systems. Of primary importance, is the substantial reduction in pollutant discharge achieved by the unique washing zone recirculation system. Because the different steps--soaking, spraying with a detergent or other soaps or chemicals, or bleach, or rinsing—are all separate, and the liquids of each station may be kept separate, liquids can be reused—and thus water input, and accordingly pollutant water output significantly reduced. In addition to lowering the total volume of sewage thus discharged, which eases disposal problems, what is discharged is highly concentrated and thus easy to clarify into solids and liquids portions, or to further treat so as to produce substantially pollution free liquid discharges. Furthermore, it is conceived that the lower total volume of detergent which will be necessary (even the possible elimination of the need for detergents) may ultimately be the most significant pollution reducer.

Economically, a very significant reduction in total labor costs, a 50 percent or more reduction in manhours in comparison to other current systems can be achieved. At the same time, since workers will not be required to handle wet or chemically treated garments, or to work under uncomfortable conditions, the working will be more pleasant than that of present systems. Water and sewage charges are reduced because of recirculation, filtration, and reuse of materials. The hardware needs for the entire system are simple, likely to be less expensive than previous hardware, and are totally versatile. Thus, the system will process together: whites and colors; heavy soil and light soil; all types of garments such as shirts, pants, coveralls, dresses, short and long coats, vests, culottes, etc., all types of garment stain conditions whether emanating, e.g., from restaurants, garages, laboratories, or hospitals; and, no-iron (e.g., made of memory fibers) and conventional garments. Using the illustrative conveyor speeds and garment spacings and the resultant component dimensions required to provide necessary cycle times, the entire illustrated system, exclusive of the make-up and recycling areas can be installed within a total plant space of 40 × 60 feet or about 2,500 square feet, which requirement may be even further reduced by stacking components and further minimizing conveyor lengths. In addition, by checking in and hanging soiled garments by customer and maintaining customer segregation during the complete process from washing to packaging, the make-up of the order to be delivered to a customer is simplified and, in comparison to other systems, practically eliminated.

Furthermore, the system provides improved removal of stain and dirt. Pre-spotting of troublesome stains, which is not possible with other systems, is now feasible and practical. The system makes possible the maintenance of a "good" white because of a minimum of dirt redeposit or "force-through". Color loss, if it occurs, will not result in color transfer. Any number of special solvents may be incorporated in a great many places in the system to release or remove troublesome stains.

The soak tank spray system, particularly due to the lack of mechanical action therein, significantly retards wearing down of fabrics. In linen supply or garment rental, since a garment is generally only worn for 4 to 8 hours between washings, wear during washing is a significant factor in average garment wear life.

The system is also particularly suited for no-iron type garments, in that it allows one to take advantage of fibers having an imposed memory with the result that the expensive and slow pressing segment of present laundry cycles can be eliminated.

Other embodiments will occur to those skilled in the art and are within the following claims.

What is claimed is:

1. In a laundering system for soiled garments, in combination, a soak zone followed by a spray zone including water spray assemblies, means to guide garments on hangers through said zones, including means for ar-

ranging adjacent garments close together with their broad surfaces faced toward one another in said soak zone, and means for separating said garments and turning them to align with the direction of travel through said spray zone whereby said garments move through said spray zone separately, and close to said water spray assemblies.

2. The laundering system of claim **1** wherein said soak zone comprises a soak tank containing a soak fluid, the garments being butted together to prevent said garments from floating to the surface of said tank.

3. The laundering system of claim **22** including conveyor means propelling said garments forward through said tank while said garments remain immersed in said tank.

4. The system of claim **2** including means to pre-wet said garments prior to entering said soak tank whereby the weight of succeeding garments can assist in forcing preceding garments down into said tank.

5. The system of claim **2** wherein said tank is in the form of a J, arriving garments being supplied to the top of the high side of said tank and resting upon one another with broad surfaces abutting one another, and garments exiting the low side of said tank, a soak fluid being located between said sides, the weight of the garments, including the added weight of arriving garments arriving at said high side serving to force soaked garments around said tank and eventually out through said low side.

6. The system of claim **5** wherein said guide means comprises, a slick rail upon which said hangers slide freely as they progress through said tank.

7. The laundering system of claim **1** adapted to economize water use and minimize polluted water discharge wherein said spray zone comprises a series of wash and rinse stations, and said means to guide comprises a conveyor system arranged to convey garments through said zones, said soak zone and said spray zones each comprise a recycle stage adapted to collect used liquids, regenerate wash and rinse liquids therefrom including filtering said used liquids, and return said liquids for soaking, washing, and rinsing, respectively and said spray zone further comprises a last rinse station adapted to receive fresh water and a collector for used water from said last rinse station adapted to collect and direct said used water, on demand, to one or more of said soak zone, said wash stations, and said rinse stations.

8. The laundering system for soiled garments of claim **1** wherein said spray zone comprises a liquid recycle stage adapted to collect used liquids and direct said liquids for reuse to said soak zone.

* * * * *

Dedication

3,780,543.—*Howard Rosenfeld*, New York, N.Y., and *Justin J. Wetzler*, Evanston, Ill. LAUNDERING SYSTEM WITH SOAK OF GARMENTS ON HANGERS. Patent dated Dec. 25, 1973. Dedication filed July 21, 1978, by the assignees, *Ludell Mfg. Co., Inc.* and *American Linen Supply Co.*

Hereby dedicate to the Public the remaining term of said patent.

[*Official Gazette August 22, 1978.*]