

[54] CONTINUOUS WASHING APPARATUS

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[52] U.S. Cl. 68/96, 68/158, 68/184

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

[58] Field of Search.....68/157, 158, 96, 183, 184

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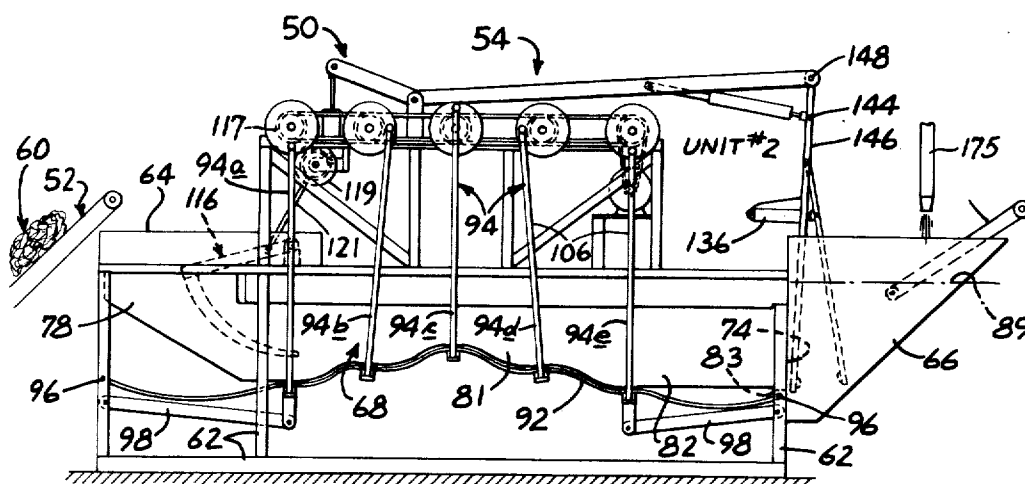
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[57] ABSTRACT

A washing unit, or a series of similar washing units for different stages of washing such as washing, rinsing, bleaching, etc; each washing unit including a flexible tube containing the water, and the goods are propelled through the tube; the propelling action is produced by a peristaltic action which also produces an agitating and washing action; it also includes a pusher to aid in starting the goods into the tube, and means for removing them from the exit end, such as a conveyor or gripper or both; the apparatus additionally includes an extracting unit continuously receiving the goods from the final washing unit and continuously extracting the water from the goods, and a drying unit continuously receiving the goods from the extracting unit and continuously drying them.

24 Claims, 35 Drawing Figures



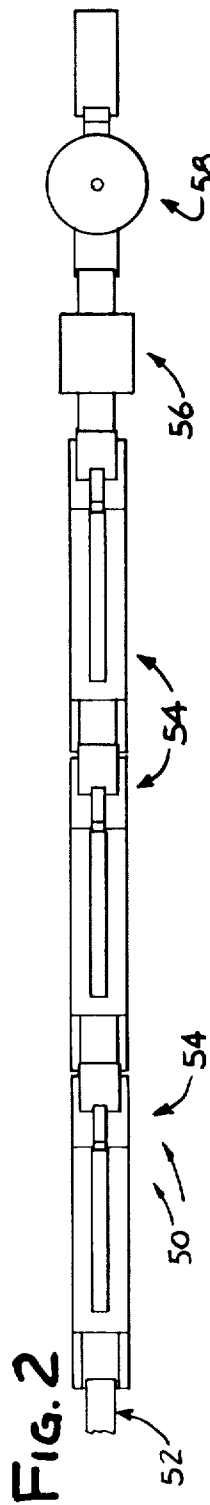
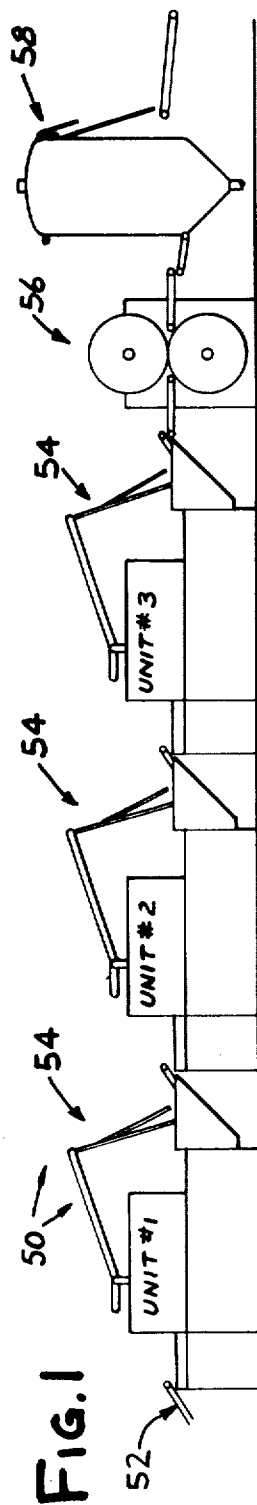
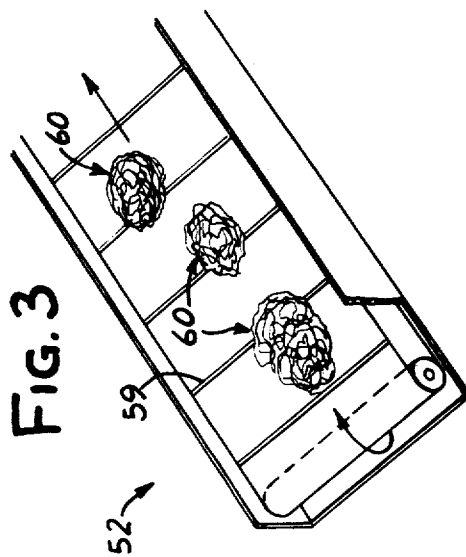
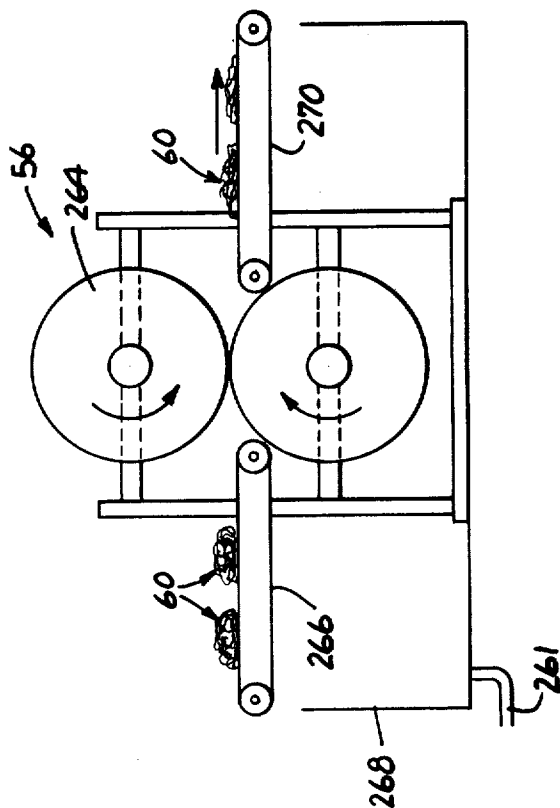
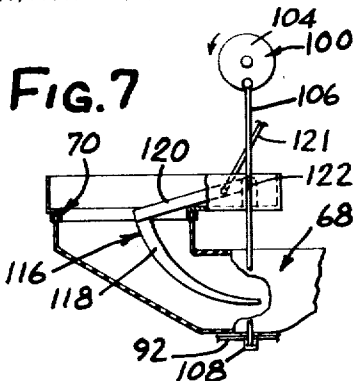
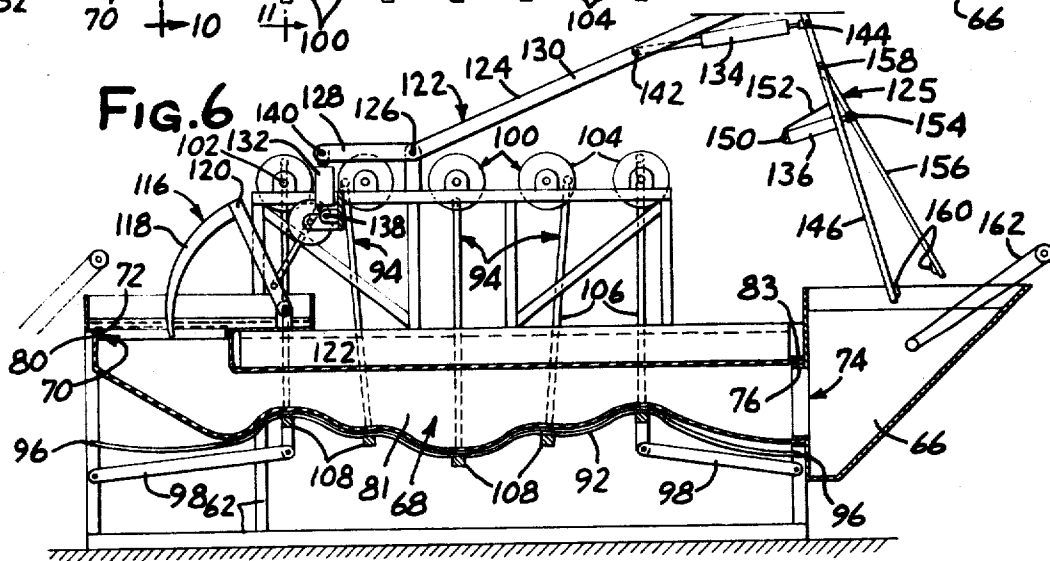
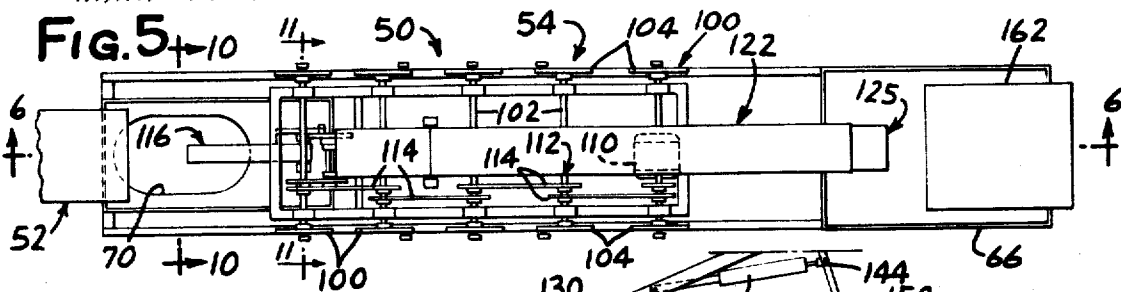
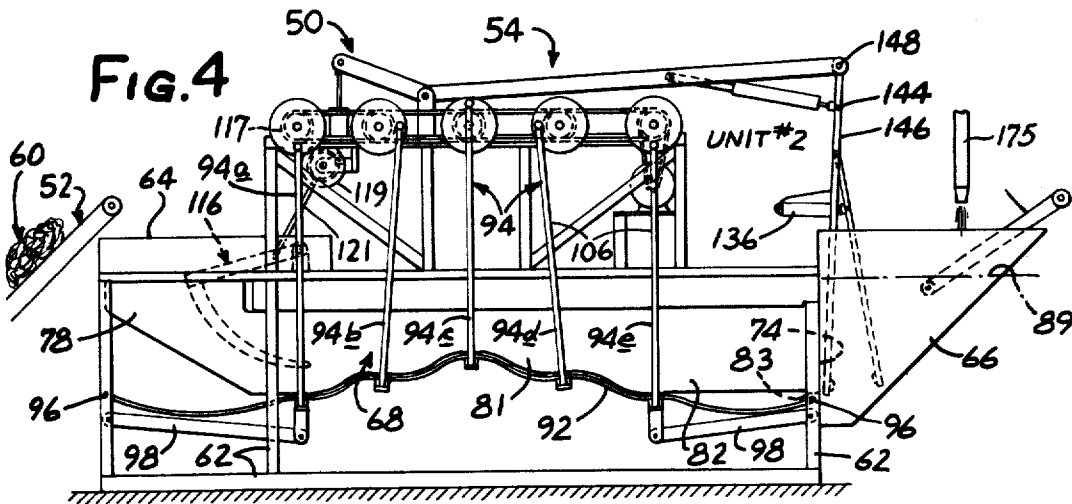


FIG. 27



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FIG. 8

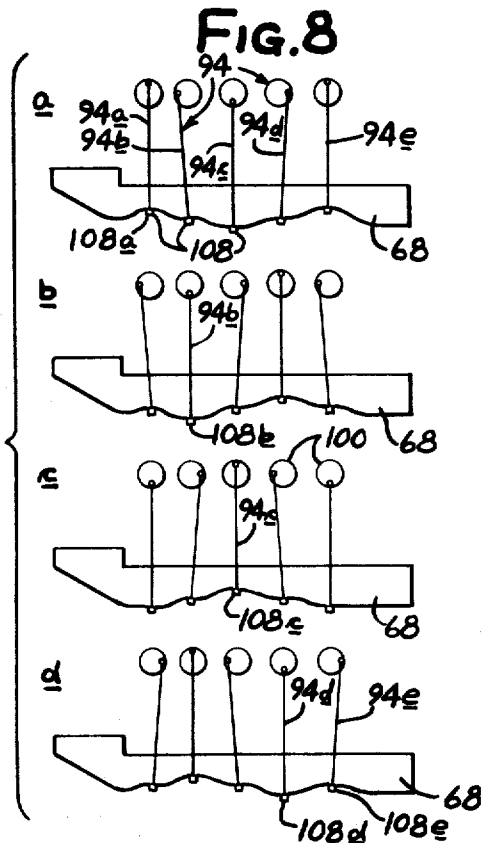


FIG. 9

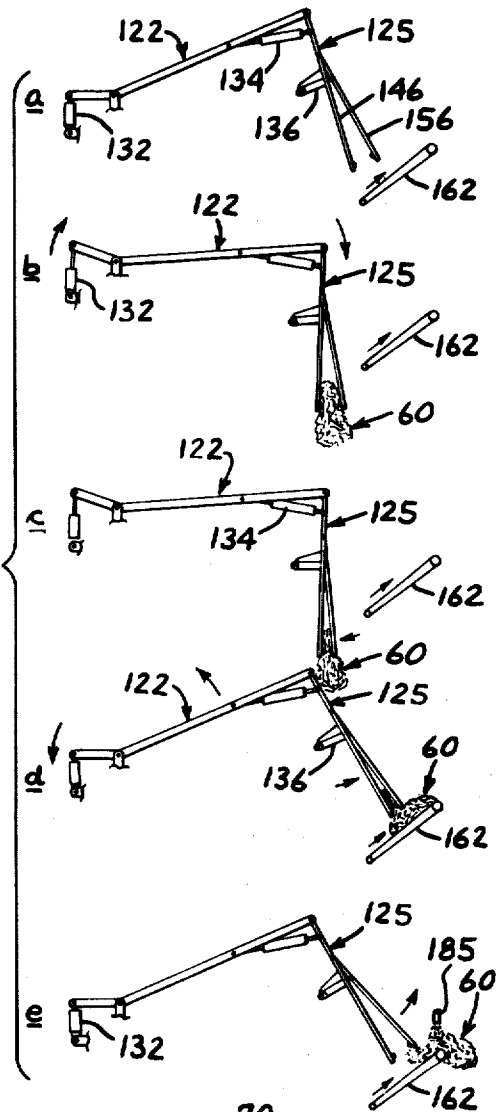


FIG. 11

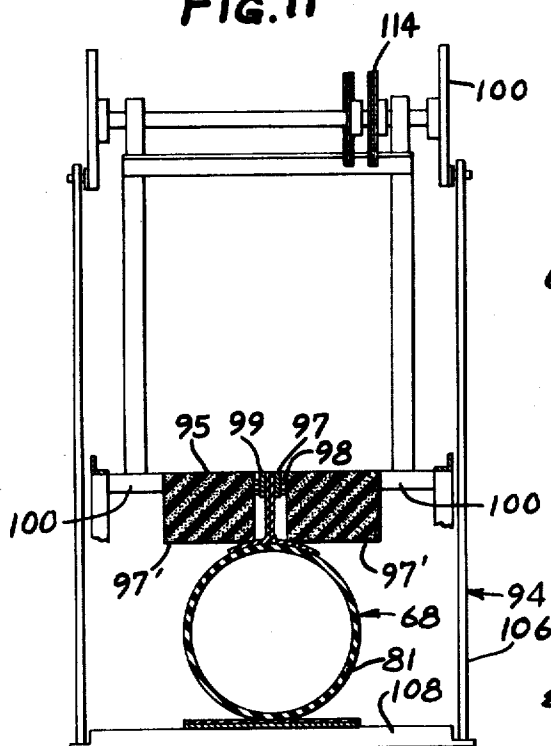
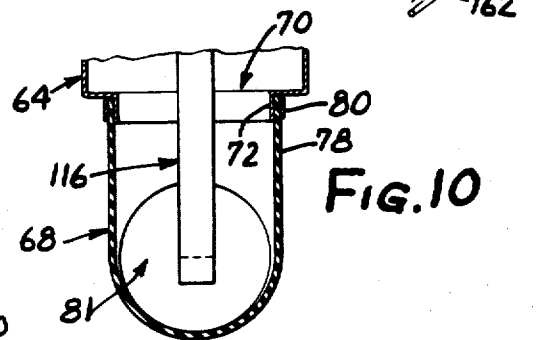


FIG. 10



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FIG. 12

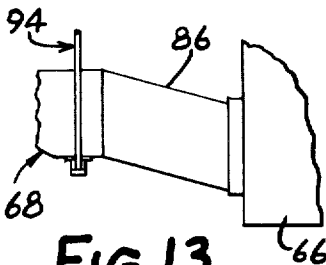


FIG. 13

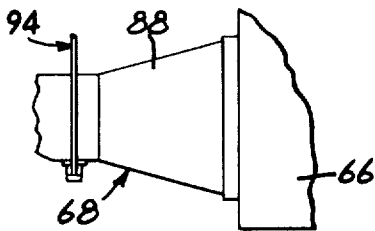


FIG. 17

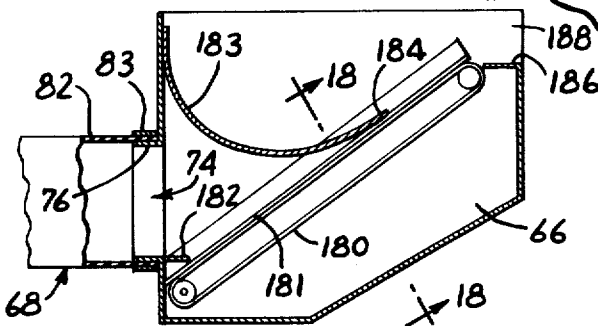


FIG. 18

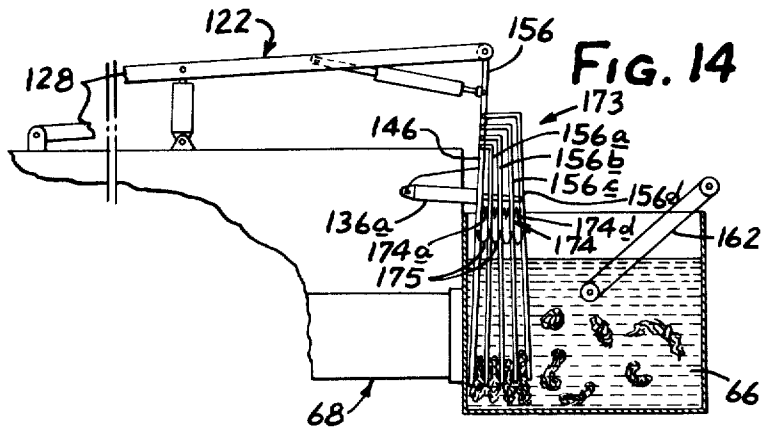
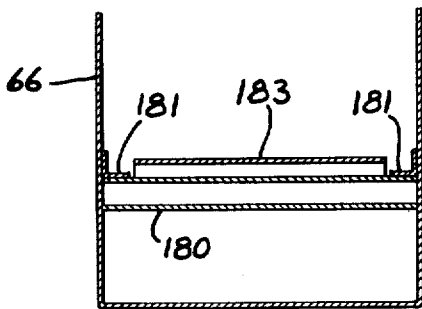


FIG. 15

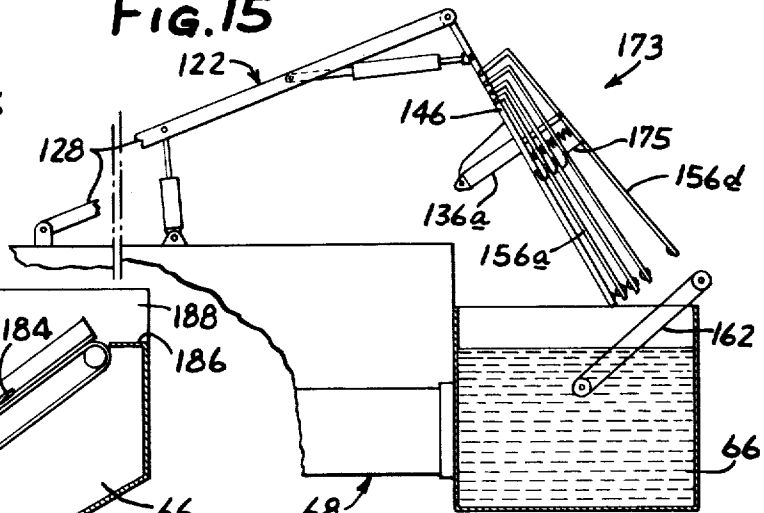
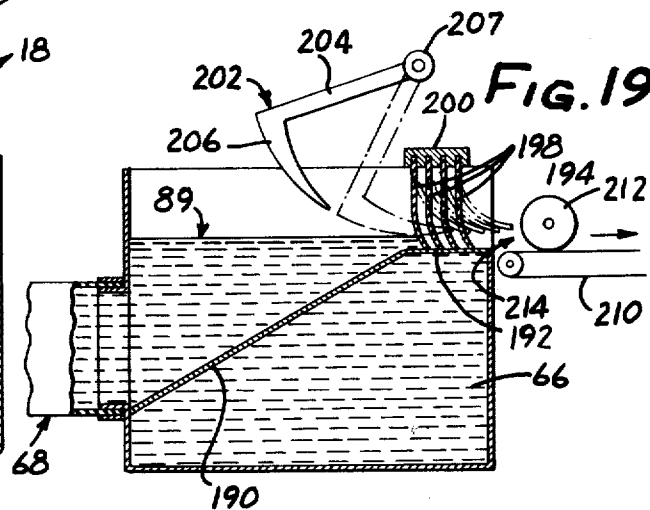


FIG. 19



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FIG. 16

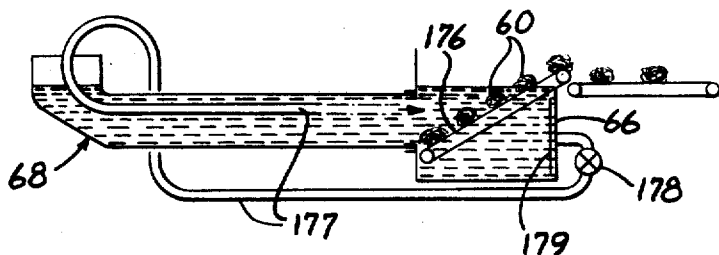


FIG. 20

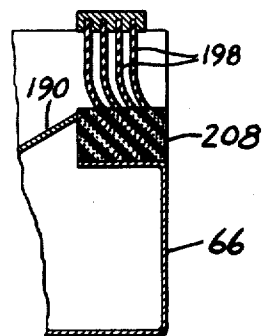


FIG. 21

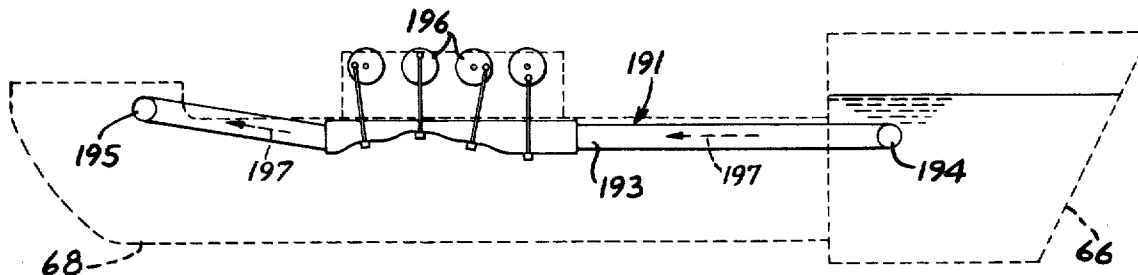


FIG. 22

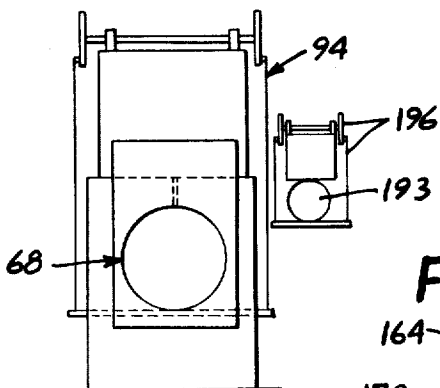
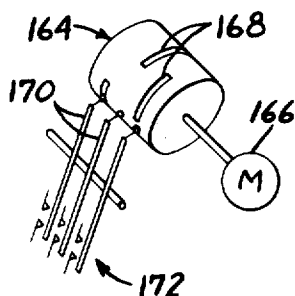


FIG. 35

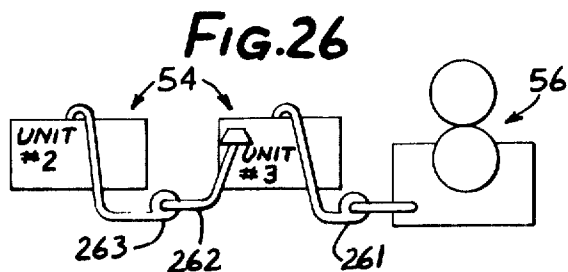
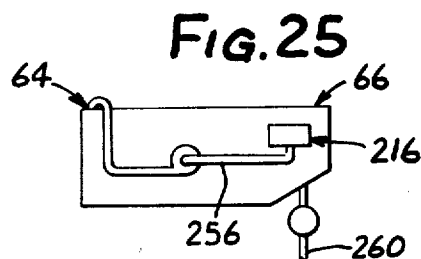
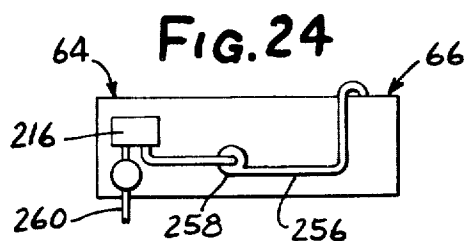
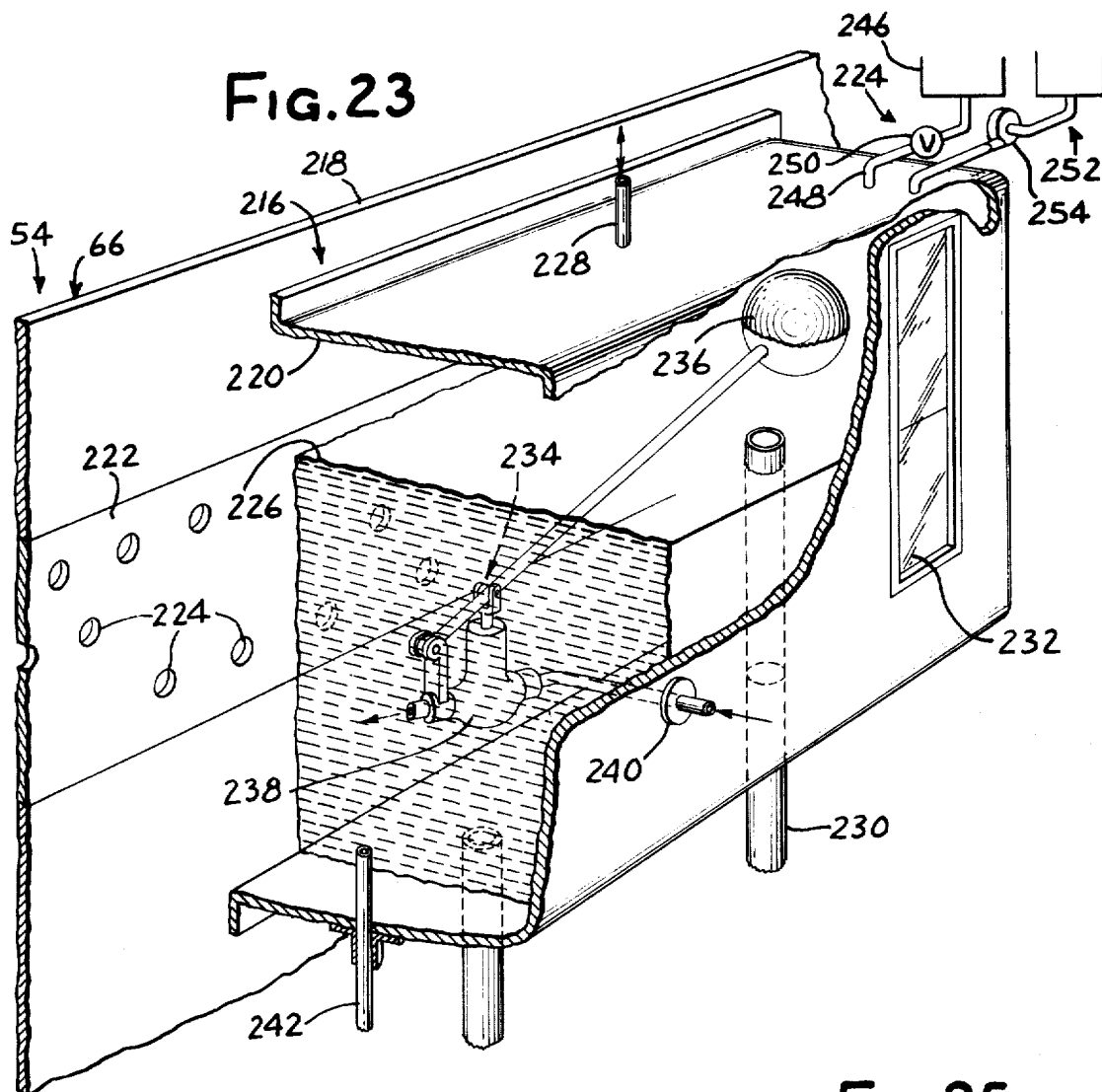
C1 168	C2	C1
C1	C2	C2
C2	C2	C2
C2	C1	C2
C2	C1 168	C1
C2	C2	C1
BOOM JACK 132	TRAVEL JACK 134	CLAMP JACK 136

FIG. 34



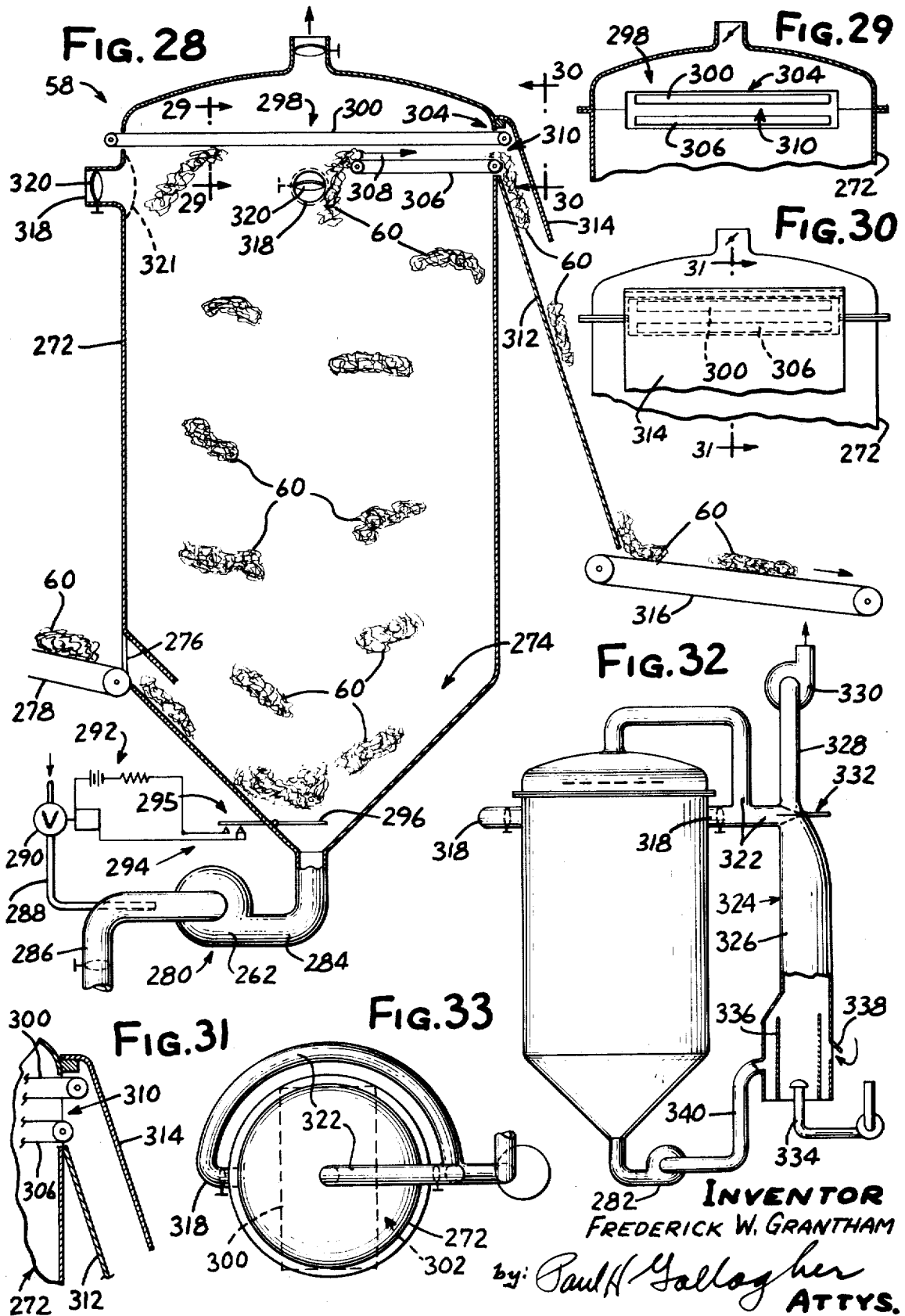
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CONTINUOUS WASHING APPARATUS

OBJECTS OF THE INVENTION

A broad object of the invention is to provide novel apparatus for continuous laundering, including washing, extracting and drying.

Another and broad object is to provide novel apparatus for continuous laundering of goods.

Another and more specific object is to provide novel apparatus for laundering goods which in the washing operation moves the goods along continuously and at the same time agitates them for producing an effective washing operation.

Another object is to provide apparatus of the foregoing general character which is effective for laundering disconnected, or relatively small, pieces as distinguished from long pieces such as continuous towels or pieces interconnected.

A further object is to provide novel apparatus for and method of laundering, utilizing a flexible tube and peristaltic action therein for producing an agitating washing action and moving the goods therethrough.

Another object is to provide a peristaltic pump for pumping liquid, either liquid alone or with solid particles therein, which thereby serves as a "no lint" pump.

An additional object is to provide a continuous laundering apparatus involving several stages, such as washing, rinsing, etc. in which both the goods being laundered and the water are continuously moved in each of the stages.

A still further object is to provide apparatus for continuous laundering of the character above referred to which is extremely flexible in its adaptation, being made up of a number of units, and whereby as many units in the washing stages may be provided as desired, such as alkali treatment, one or more soap washing treatments, rinsing, bleaching etc.

Still another object is to provide apparatus of the foregoing character for laundering which includes a novel dryer.

A still further and broad object is to provide a new kind of laundry dryer.

A further object is to provide such a dryer that is of continuous character, that is, the goods to be dried are introduced into the dryer in a continuous stream, they are dried in the dryer in a continuous operation, and they are removed from the dryer in a similar continuous stream.

Still another object is to provide a novel dryer which is of continuous nature in that the wet goods are introduced in a continuous stream, and after drying, the goods are removed from the dryer in a continuous stream, and in which a continuous air stream is introduced at the bottom of the dryer and it flows upwardly, the wet goods because of their heavier weight remaining toward the bottom of the dryer and as they begin to dry and lighten in weight, they are suspended in the air stream and are removed from the dryer adjacent the top thereof.

Another object of the invention is to provide a dryer of the foregoing character in which the air stream in moving upwardly continuously dries the goods, and as the goods are progressively dried, they are suspended progressively higher, so that the driest, and the dry, pieces are suspended at the top of the dryer, and such dry pieces are removed from the dryer at that point.

Still another object is to provide a continuous dryer of the kind just referred to having novel safety means for shutting off the fuel for heating the air stream, in the event that a momentary quantity of wet goods should be introduced into the dryer of greater quantity than the maximum air stream would be capable of lifting.

An additional and broad object of the invention is to provide a method of continuous laundering.

Still another object is to provide a novel method of continuous laundering which includes continuous movement of the goods and continuous movement of water.

Still another and broad object of the invention is to provide a novel method of laundering which includes a washing phase, an extracting phase and a drying phase, all in a continuous series.

A further object is to provide a novel method of laundering of the character just referred to which includes steps of constantly maintaining a predetermined condition of water in the washing phase, such as a predetermined amount of soap or suds, a predetermined pH condition, together with continuous recirculation, replenishment, and movement of the water from a lesser saturated condition such for example as rinse water after it has performed a rinsing function being continuously introduced into the alkali and/or soap water etc.

A still further object is to provide a novel method of laundry drying.

DESCRIPTION OF A PREFERRED EMBODIMENT

In the drawings:

FIG. 1 is a side elevational view, of small scale and semi-diagrammatic in nature, of the overall apparatus embodying the features of the present invention;

FIG. 2 is a top view of the apparatus of FIG. 1;

FIG. 3 is a perspective view of a portion of a conveyor of the type particularly suitable for introducing the goods into the main laundering apparatus;

FIG. 4 is a large scale side elevational view of a washing unit incorporated in the apparatus;

FIG. 5 is a top view of the washing unit of FIG. 4;

FIG. 6 is a longitudinal vertical sectional view taken at line 6—6 of FIG. 5 and thus oriented according to FIG. 4;

FIG. 7 is a view of the left hand end of FIG. 6 but with certain of the movable parts in alternate positions;

FIG. 8 is a view principally diagrammatic in nature, showing certain moving operating parts in different positions in a series of steps;

FIG. 9 is a view principally diagrammatic in nature, showing the means for removing the goods from a unit with certain operating parts in different positions in a series of steps;

FIG. 10 is a transverse vertical sectional view taken at line 10—10 of FIG. 5;

FIG. 11 is a transverse vertical sectional view taken at line 11—11 of FIG. 5;

FIG. 12 is a diagrammatic side view of a portion of the washing tube showing an alternate construction thereof;

FIG. 13 is a diagrammatic side view of a portion of the washing tube showing another alternate construction thereof;

FIG. 14 is a longitudinal sectional view of the exit end of washing unit showing a gripper for removing the goods from the unit;

FIG. 15 is a view similar to FIG. 14 but with the gripper in a released position;

FIG. 16 is a view similar to FIG. 14 showing an alternate means for removing the goods from the unit;

FIG. 17 is a view similar to FIG. 14 showing another alternate form of means for removing the goods from the washing unit;

FIG. 18 is a view taken at line 18—18 of FIG. 17;

FIG. 19 is a view similar to FIG. 14 but showing another alternate form of means for removing the goods from the unit;

FIG. 20 is a view similar to FIG. 19 but showing a still further alternate forms of means for removing the goods from the unit;

FIG. 21 is a side view, partially diagrammatic, showing a peristaltic pump;

FIG. 22 is an end view of FIG. 21 and showing additional frame means;

FIG. 23 is a perspective view, with portions broken away, of a unit attached and incorporated in a washing unit, and including various instrumentalities, this view also incorporating a portion of the washing unit itself;

FIG. 24 is a small scale diagrammatic view of a washing unit showing means for recirculating water therein;

FIG. 25 is a view similar to FIG. 24 but showing means for recirculating water in a different direction;

FIG. 26 is a small scale diagrammatic view of several units of the apparatus and including means for moving water from one unit to another;

FIG. 27 is a side elevational view of the extractor or extracting unit incorporated in the apparatus;

FIG. 28 is a side elevational view, partially diagrammatic in nature, of the novel dryer of the invention;

FIG. 29 is a view taken at line 29—29 of FIG. 28;

FIG. 30 is a view taken at line 30—30 of FIG. 28;

FIG. 31 is a view taken at line 31—31 of FIG. 30;

FIG. 32 is a side elevational view of a dryer generally similar to FIG. 28 but showing a different form of heating means, and showing a recirculating means;

FIG. 33 is a top view of the device of FIG. 32;

FIG. 34 is a perspective diagrammatic view of a motor and cam means for controlling certain operating instrumentalities in the washing units; and

FIG. 35 is a developed diagrammatic view of the cam means represented in FIG. 34.

Referring in detail to the drawings, attention is directed first to FIGS. 1 and 2 which show in diagrammatic form the overall apparatus embodying the features of the invention. The apparatus in its entirety is indicated at 50 and includes as the major components or units thereof an entrance conveyor 52, a plurality of washing units 54, in this case three, individually identified as No. 1, No. 2, No. 3; an extractor or extracting unit 56, and a dryer or drying unit 58. The apparatus thus represented in FIGS. 1 and 2 is a complete apparatus for continuous laundering, including washing which in itself may be broken into other phases such as soaking, alkali-ing, soap, or washing proper, rinsing, bleaching, etc; and extracting, and drying. The various components or units are described in detail hereinbelow.

Referring to FIG. 3 the conveyor 52 may be of known type but preferably includes a moving conveyor element 59 preferably in the form of a web and slat construction and of suitable dimensions for accommodating the desired quantity of goods to be laundered. The goods are indicated generally at 60 and may be of nearly any character, with particular emphasis on the fact that they may be of pieces, detached from one another as distinguished from continuous towels, whereby any kind of goods can be accommodated whether large, small, long or short, such that the various pieces of the goods follow one another, and they may be so sparse as to be separated from one another, or they may be of such density as to overlap, but the consideration is that they are detached. Such goods 60 are conveniently handled by the conveyor belt for receiving the goods from any source, such as an automatic feeder, or manually introducing them to the conveyor from a cart. The conveyor is arranged for introducing the goods into unit No. 1, and thus into an operation that includes washing the goods in the several units 54, then extracting in the unit 56 and then finally drying them in the unit 58.

Reference is next made to FIGS. 4-7 which shows in large scale one of the washing units 54, for convenience unit No. 1, which is the first unit, receiving the goods from the conveyor 52 and delivering them to unit No. 2. The washing unit 54 includes a suitable framework 62 having an entrance tank 64 and an exit tank 66, and a flexible tube 68 connected therebetween. The tank 64 has a bottom opening 70 having a downwardly extending surrounding flange 72 and the exit tank 66 has a side opening 74 provided with a surrounding flange 76. The flexible tube 68 may be of rubber or rubber like product, reinforced, for providing suitable strength but also being sufficiently flexible for enabling the flexing movements in the washing and peristaltic movements of the goods, as referred to again hereinbelow. The tube may be preshaped, having an entrance end portion 78 encompassing the flange 72 to which it is secured by suitable means such as a band 80, and a main section or body 81, and a terminal end portion 82 surrounding the flange 76 to which it is secured by a band 83. The main section 81 is preferably generally cylindrical, but it may be desired on occasion to provide it with a terminal end portion 86 (FIG. 12) which is inclined downwardly, or alternatively with a conical terminal portion 88 (FIG. 13).

The flexible tube 68 receives the goods from the entrance tank 64 and empties them into the exit tank 66. The tube and tanks form a container for containing the water and goods, the water for example being at a convenient level 89, preferably above the top of the tube.

Underlying the flexible tube 68 is a flexible strip 92 (FIG. 6) such as of belting, and that strip and the flexible tube are supported by a plurality of agitators 94 to be described in detail hereinbelow. The flexible strip 92 is secured at its ends at 96 to the framework and is of a length greater than the distance between the points of recurrence to provide full flexibility accommodating the agitators and the flexing of the tube 68. However the end portions of the strip 92 are secured against undue endwise displacement by rods 98 pivoted at one end on the framework and at their other end secured to the outermost agitators to prevent undue longitudinal

displacement as might otherwise be caused by the vertical movements of the agitators. The strip 92 is also secured to the outermost agitators.

Each of the agitators 94 includes crank means 100 mounted preferably at the top of the framework, each crank means including a shaft 102 and a pair of discs 104 fixed thereon. Secured to the discs are connecting rods 106 as in pitman or cranking relation, these connecting rods extending downwardly to below the flexible tube where they are connected with cross bars 108 underlying the flexible tube and the flexible strip 92. Upon rotation of the shaft 102 and the crank members 104, the cross bars 108 are worked or operated vertically in a manner described hereinbelow. The respective agitators 94, which in the present instance are five in number, are offset progressively, in this case 90° to provide a wave motion, or peristaltic action to be described again hereinbelow. The agitators are driven by a suitable means such as a motor 110 which has a suitable drive connection 112 with the agitators such as by chain drive means 114.

The agitators 94 are distributed along the flexible tube 68, and are identified individually as 94a, 94b, 94c, 94d and 94e. Upon turning of the crank means, the cross bars 108 are moved up and down and they produce an agitating and progressive wave action, or peristaltic action of the flexible tube 68. As indicated above the relation of the movement of these members is progressive, providing a wave motion, and as indicated in FIG. 8a the first cross bar 108a is uppermost, the second cross bar 108b is at a half-way position, the next cross bar 108c is in lowermost position, the fourth one 108d is at an intermediate position on its way up, and the fifth 108e is in uppermost position, in the same position as the first one, 108a. Upon rotation of the crank means 100 in the various steps as represented in the four stages of FIG. 8 — the up and down movements of the bars 108 is progressive, i.e., beginning with the first one 108a, and leading through the series from left to right as illustrated. While the first bar 108a has reached the top and is receding, the second one 108b is progressing to the top and the third one 108c is progressing from the bottom up to its mid portion, etc. This movement continues from the first 108a, to the last 108e, with a continuous wave movement. The bars 108 in their vertical movements flex the flexible tube 68 so that the goods in the tube are pushed along therethrough, each bar pushing them to the next. This action is known as a peristaltic action, or wave action, similar to that in tubes in an animal body, e.g., the esophagus.

The goods are introduced into the washing unit by placing them in the entrance tank 64. In the case of the No. 1 unit 54, they are introduced by the entrance conveyor 52 and then they migrate through the unit in the washing operation.

Each washing unit 54 includes a pusher 116 which includes a curved pushing element 118 mounted on an arm 120 pivoted at 122 on the frame. This pusher 116 is driven preferably by the adjacent shaft 102 as through a chain 117 and crank 119 having a link 121 pivotally connected with the arm 120 and is arranged for action in synchronism with the agitators 94, and upon operation of it, it swings from its full retracted position shown in FIG. 6 when the first agitator is up-

permost and then progressively to a fully projected position FIG. 7 when the first agitator is lowermost. The purpose of this pusher is to start or initiate movement of the goods from the entrance tank 64 into the entrance end of the flexible tube 68 and start them through the tube. For example as the goods are deposited in the entrance tank, they fall or move into the entrance end portion of the flexible tube and to more effectively start them through the tube, the pusher 116 is moved as stated. The pusher may be disposed and dimensioned for pushing the goods into the range of the first agitator 94a, or therebeyond, as desired, and then upon upward movement of the first agitator 94a the pusher is retracted, and moved out of interference with that agitator, and the goods that were moved to that position are moved through the tube by that agitator; the goods are then on their way toward the second agitator 94b and the latter again picks up the action and moves the goods toward the third one. At the same time, the agitators cause an active movement of the water and the goods in the tube, with a complete agitation and sloshing thereof and corresponding complete washing action.

The extent of movement of the connecting rods 94 and cross bars 108 may be as desired with respect to the vertical dimensions of the flexible tube. For example that movement of the bars 108 may be one half of the diameter of the tube, or more, or less, depending upon the desired extent of agitation and washing action, the invention of course not to be limited to any particular degree of such movement.

The underlying flexible strip 92 is considered to be of importance, because of the relatively great action of the agitators on the tube. The cross bars 108 move somewhat in longitudinal direction, and would tend to slide on the tube, but because of the flexible strip 92, this sliding action, or any other type of friction developed, is absorbed by that strip and not transmitted to the tube, except possibly in a very minuscule degree. The flexible strip 92, may be easily replaced and is very inexpensive. The end cross bars are secured in place longitudinally, and prevent the migration of the flexible strip 92, and with this securement at the said two points, the intermediate portion may wander somewhat but it does not become displaced to such an extent as to cause any objectional action on the flexible tube itself.

The main support for the flexible tube 68 is provided by the flexible strip 92 and the agitators 94, but it does of course derive a degree of support from its connection with the entrance tank and the exit tank. The tube is provided with a strip or fin 95 (FIG. 11) formed integrally with the tube, or secured thereto as by cementing, vulcanizing etc. This fin is disposed at the top of the tube and extends upwardly, and is substantially the full length of the main section of the tube and its upper edge is secured to the frame where it is secured between a frame element 99 and another strip 97 secured thereto with the fin therebetween, by suitable means such as bolts 98. It is to be stated that the strip 97 is readily removable for facility in removing the flexible tube when desired. The fin serves principally to stabilize the tube against lateral displacement, but also provides a small degree of vertical support.

Above the main section 81 of the flexible tube 68 are a pair of pads or blocks 97' of rubber or rubber-like

material, and for example cellular rubber, these blocks being disposed on opposite sides of the fin 95 and extending substantially the full length of the main section of the flexible tube. These blocks may be secured in place by suitable means, such as by mounting them on frame elements 100. These blocks provide cushioning for the tube in the flexing of the latter, and also support for it against sidewise displacement.

Upon the goods emerging from the flexible tube and being deposited in the exit tank 90, they are then removed from that tank in a step of the progression of the continuous laundering by one form of means indicated in its entirety at 122. This means includes a boom 124 including a gripper or clam shell 125, the boom in the present instance being pivoted at 126, on the frame and having a first arm 128 and a second arm 130. The boom 122 is actuated by a double acting air cylinder or jack 132 and it carries an additional double acting air cylinder or jack 134. The air cylinder 132 is pivotally mounted at 138 on a fixed element of the frame and has a piston pivotally connected at 140 with the first arm 128 of the boom. The air cylinder 134 is pivotally connected at 142 on the arm 130 and the piston thereof is pivotally connected at 144 on a main gripper arm 146 pivoted at 148 on the arm 130 of the boom. Another air cylinder or jack 136 is pivotally mounted at 150 in a frame 152 carried by the main arm 146 and its piston is pivotally connected at 154 on an auxiliary gripper arm 156 which itself is pivoted at 158 on the main arm 146. The arm 156 is movable toward and from the main arm 146, and these two arms together constitute a gripping means for gripping the goods from the exit tank and moving them to a conveyor means for conveying them from the washer unit. The arms 156, 146, may be provided with suitable opposed gripping elements 160 positioned for appropriately gripping the goods therebetween.

The goods removal means 122 is operative for picking the goods from the bottom of the exit tank 66 after they emerge from the flexible tube, and depositing them on the conveyor 162. This is accomplished by the movement of the removal means in a series of steps represented in FIG. 9; in a first position the boom is in upper or retracted position as represented in FIG. 9a to which it is moved by the jack 132; in this position the jack 134 is retracted and the jack 136 is extended, opening or separating the arms 156, 146; in the next step represented in FIG. 9b the jack 132 is extended, rocking the boom 122 in clockwise direction and moving the extended end downwardly whereby the arms 156, 146, while still separated, are extended into the exit tank 66; the extent of projection of these arms into the tank may be as desired, and different extents under different circumstances, but generally, they extend down to beyond the middle of the outlet of the flexible tube (FIG. 4); while the right hand end is in such downwardly projected position, and the arms 156, 146 yet separated, the jack 136 is contracted, closing the arms and gripping the goods in the exit tank, as represented in FIG. 9c thereupon the boom 122 is rocked in counterclockwise direction to raise the extended end as in FIG. 9d and when the boom is so raised or as it is being raised, the jack 134 is extended to swing the arms 156, 154 which are then still closed and gripping the goods, outwardly to the position of

FIG. 9d in which the lower ends of the arms are positioned above the conveyor 162; when this position is assumed, the jack 136 is extended, moving the arm 156 away from the arm 154 as in FIG. 9e, and releasing the goods which drop onto the conveyor 162. Following the foregoing series of steps, and to begin a new sequence of steps, the jack 134 is retracted, moving the arms 156, 154 back to the position of 9a and the series of steps described above are repeated. The conveyor 162 is then operative for carrying the goods from the exit tank to the next stage in the operation, namely to the extractor unit 56.

FIGS. 34 and 35 show a control means for controlling the operation of the goods removing means 122. In this construction a cam means 164 is driven by a suitable motor means 166, the cam means preferably being in the form of a cylinder having notches or grooves 168 forming camming elements engageable by follower elements 170 which are operative for controlling switch means 172. These switch means are incorporated in electrical circuits for controlling the respective air cylinders or jacks 132, 134, 136 in a known manner. FIG. 35 is a developed representation of the cam means 164 showing the steps in the control of the switches 172 and the jacks, the diagram indicating the respective positions of the grooves 168 with respect to each other and with respect to the progress of the rotation of the cam means 164. In this representation the air cylinders or jacks are indicated at the respective stages of the diagram and in each case the condition of the jacks are indicated as: C1 contracted, and C2 extended.

An alternate form of gripping means 173 is represented in FIGS. 14 and 15 in which instead of a single supplementary or auxiliary arm 156 a plurality of such arms 156a, 156b, 156c, 156d are provided, mounted on the main arm 146. In this case the jack 136, here identified as 136a may be of flow valve type, fast closing and slow opening, this construction being known. Interposed between the respective pairs of adjacent arms, 146-156a, 156a-156b, 156b-156c and 156c-156d are a series of compression springs 174, individually identified as 174a, 174b, 174c and 174d. These springs are progressively weak to strong, in the order referred to. The specific purpose of the construction represented in FIGS. 14 and 15 is to eliminate concentration of the goods in the removing operation and place them on the conveyor 162 in a more gradual manner or progression. For example when the arm 146 with the attached arms is lowered into the exit tank, the various arms are closed on the goods therein and the goods are gripped between the respective pairs of adjacent arms, namely in a series of groups or "bites"; then when the boom is raised and the arm assembly 173 is swung over the conveyor, the arms are separated individually, or progressively, so as not to deposit a full and large mass of goods onto the conveyor; specifically the strong spring 174d first operates to move the arm 156d away, releasing the goods gripped between the arms 156d, 156c, then the next spring 174c pushes the arm 156c away from the arm 156b, releasing the next small bite of goods, and then the third and fourth springs follow, resulting in an individual depositing of the different small bunches or bites of goods onto the conveyor; the slow opening of the air cylinder or jack

136 enables this progressive separation of the arms and corresponding progressive deposit of the goods onto the conveyor. Ties 175 interconnect the adjacent arms to limit separating movement thereof, and in so doing first limit the movement of the strongest spring, then the weaker ones progressively.

A rinsing nozzle 175 (FIG. 4) is provided for rinsing the goods as the goods emerge from the washing units, preferably positioned above the exit conveyor 162. Such nozzle may not be required in the case of a rinsing unit.

In the construction of FIG. 16, a conveyor 176 of mesh or openwork form in the exit tank 66 receives the goods directly from the exit tube 68. A recirculating line 177 including a pump 178 withdraws water from under the conveyor 176 in the exit tank and re-introduces it into the tube adjacent the exit end and thus into the tank above the conveyor. This action produces a "vacuum" at the conveyor, or a flow-through of the water, that holds the goods on the conveyor which then effectively carries them out. Preferably a filter 179 is provided to catch lint that may be dislodged from the goods.

FIGS. 17 and 18 show another and alternate form of means for removing the goods from the exit tank 66. In this case a suitable belt conveyor 180 is provided, leading from a position below the exit end of the flexible tube 68 and rising in exit direction. The conveyor 180 may be of a width substantially the width of the tank, and preferably flanges 181 are secured to the side walls and lead inwardly over the side edges of the conveyor to prevent the goods from drifting down over the side edges of the conveyor. If desired the exit tank may be provided with a flange 182 extending inwardly into the exit tank so as to provide a lip over which the goods ride or fall onto the conveyor 176.

Preferably a pressure shield 183 is provided, secured to the wall of the exit tank and curved downwardly and then upwardly in exit direction, and having a terminal flexing end portion 184 biased downwardly against the conveyor. At the upper and exit end of the conveyor is a lip of shelf 186 for receiving the goods from the conveyor and leading to and through an outlet 188 in the tank, which may then communicate with a succeeding instrumentality, such as a conveyor leading to the extractor 56.

As the goods emerge from the tube 68 into the exit tank, they fall on the conveyor, and as they accumulate thereon they form a mass that is carried up by the conveyor, the pressure shield 182 providing the desired reaction against the conveyor for so conveying the goods therealong.

Attention is next directed to FIG. 19 showing another form of means for removing the goods from the exit tank. A stationary slide 190, e.g., of stainless steel, preferably the width of the tank 66 has a lower edge disposed under the outlet of the tube 68 for receiving the goods therefrom and leads upwardly in exit direction, terminating in an element 192 which may be horizontal and which leads to an outlet opening 194. Above the element 192 are a plurality of leaves 198 of rubber or rubber-like resilient material, mounted in a block 200. These leaves are for example four in number, arranged in tandem relation exit direction, and also extending fully across the tank. They are of a

vertical length or dimension greater than the distance down to the element 192 whereby they bend over or drag, being deflected outwardly in exit direction.

Included in the construction represented in FIG. 19 it is a pusher 202 of construction similar to the pusher 116 identified above. In this case the pusher includes an arm 204 and a curved pusher element or blade 206, the pusher being mounted on suitable means such as a transverse shaft 207. The pusher is arranged for oscillating movement between a retracted position shown in full lines and an advanced position shown in dot-dash lines. The goods are carried up the slide 190 by the surging of the water, and also by pushing by other goods therebehind, up to the top of the slide where they accumulate at the leaves 198 and when the pusher is moved downwardly to its dot-dash line position, it engages the goods and pushes them in exit direction between the element 192 and the leaves 198, this action forming an opening between those members, in which the goods are pushed onto a conveyor 210 above which is a reaction or gripping roller 212 forming a bight 214 therebetween. The pusher 202 in pushing the goods as referred to, pushes them into the bight 214 where they are gripped between the roller 212 and the conveyor, and carried by the latter therealong, indicated by the direction arrow.

The exit tank is so positioned and constructed relative to the flexible tube 68 that the normal or desired water level 89 is at or closely adjacent the level of the element 192. The leaves 198 are self biased to the retracted or the full line position indicated, and engage the element 192 and form a seal therewith normally preventing the flow of water therethrough. However due to the movement of the goods, and the violent sloshing action, the water assumes the form of waves and at times reaches a height substantially above the level of the element 192. However the sealing effect between the leaves 198 and the element 192 prevents the escape of any significant amount of water therethrough. Additionally the movement of the goods therethrough prevents the egress of any substantial quantities of water.

It may be desired that instead of the terminal element 192 (FIG. 19), a block 208 be used, as shown in FIG. 20, extending across the tank and preferably composed of closed cell sponge rubber.

FIGS. 21 and 22 show a peristaltic recirculating pump 191 in addition to the tube 68 and agitators 94. In this instance a flexible tube 193 has an inlet 194 communicating with the exit tank 66 and an outlet 195 communicating with the entrance end of the flexible tube 68 (or with the entrance tank 64), and agitators 196 are provided similar in construction and functioning to the agitators 94, but arranged and driven so as to pump the water in the opposite direction as indicated by the arrows 197. This construction provides a "no lint" pump, i.e., it has a passage constantly open but alternately contracted and expanded. The tube 68 and agitators 94 also forms a pump — for moving the goods. Other arrangements for recirculating and transferring water are described hereinbelow.

Reference is now made to FIGS. 23-26 showing a housing unit 216 secured to a washer unit 54, and enclosing or accommodating various instrumentalities used in the operation of the apparatus. The unit 216

may be mounted for example on the exit tank 66, including a housing 220 secured directly to the wall 218 and forming a cell closed to the exterior, except for pipe lines, etc., and communicating with the interior of the exit tank through a perforate panel 222, providing free flow of water between the exit tank and the interior of the housing. This panel may be of screen type, or it may be of sheet metal with a large number of apertures 224 for providing the free flow of liquid as mentioned, but providing a smooth inner surface so as to eliminate any possible snagging or interruption of the movement of the goods. The water in the unit is indicated as having a level 226 which of course is the same as that in the exit tank, but the level is not associated with the top of the perforate panel 222. The housing includes a vent 228, an overflow pipe 230 leading to drain, and a level sight gauge window 232. The unit 216 is also effective for accommodating a float unit 234 having a float element 236 which controls an inlet valve 238 in an inlet pipe line 240. Normally the float unit will control the level of the water, but the overflow pipe 230 provides a top limit to any such level.

A pH meter 242 may be mounted in any suitable portion of the unit, such as in the bottom as shown, and for changing the pH condition, a supply unit 244 may be provided, this unit including a container 246 and a line 248 with a control valve 250 therein, the line leading into the interior of the housing, enabling the pH fluid to enter by gravity. If desired another type of unit may be desired instead, such as the unit 252 having a pump 254 for positively feeding the pH fluid into the water.

The apparatus and the method of the invention include recirculation of the water in each washer unit, in an arrangement such as shown at FIG. 24 or FIG. 25. In FIG. 24 a pipe line 256 leads from the entrance tank 64 and includes a pump 258 for pumping the water into the exit tank 66. In this arrangement, the water circulates through the washing unit in direction opposite the flow of goods therethrough, i.e., from the exit end to the entrance end, but if it is desired to re-circulate the water in the same direction as the flow of goods, it may be done as represented in FIG. 25, where the line 256 receives water from the exit end and pumps it into the entrance end. In these cases, a unit 216 of the kind described above may be utilized, in the one case secured to the entrance tank and in the other case to the exit tank. Each washing unit also includes a drain line 260, at a convenient low point.

It is also contemplated that the water extracted from the goods in the extractor 56 may be transmitted to one of the washing units, such as the adjacent one, No. 3, and this may be done by placing the extractor sufficiently high that the water will run by gravity into the next washing unit. If it should be desired, however, not to place the extractor unit so high, the water may be withdrawn from the extractor unit and positively forced into the washing unit such as represented in FIG. 26 by means of a pump 261.

It is further contemplated that water be flowed from one washing unit to the next such as from a rinsing unit (e.g., No. 3) to an alkali or a soap unit (e.g., No. 2), and this may be done as represented in FIG. 26 where a line 262 connects the units and includes a pump 263.

Attention is directed to the extractor or extracting unit 56 (FIG. 27). The extractor includes a pair of pressure rollers 264 driven by suitable means and providing sufficient pressure for extracting the greatest portions of the water from the goods. The goods 60 are carried on a conveyor 266 which receives them from any suitable source, such as the conveyor 162 of FIG. 9. The goods are delivered by the conveyor 266 to the rolls 284 and upon extraction, the water runs into a tank 268 and then the goods move onto an exit conveyor 270. As indicated above, and as represented as FIG. 26, a pipe line 261 connects with the tank 268.

Attention is then directed to FIGS. 28-33 showing drying means and identified above as the dryer or drying unit 58. The drying unit as represented in FIG. 28 includes a tank 272 having a main body portion preferably cylindrical and a hopper bottom portion 274. The tank has an inlet opening 276 through which the goods 60 are introduced into the tank by a suitable conveyor means 278 which may receive the goods from for example the conveyor 270 of the extractor 56, FIG. 27.

A burner unit 280 is provided for drying the goods in the tank, this burner unit including a pressure blower 262 having an outlet line 284 leading into the bottom of the hopper portion of the tank. Leading to the blower is an air inlet line 286, and leading into that line is a gas line 288 having a control valve 290 controlled by circuit means 292 which includes a switch 294. The switch means includes a contactor lever 295 having an arm or vane 296 which has its inner end adjacent the bottom of the hopper portion 274 for receiving the goods thereon as the latter are introduced into the dryer.

Upon operation of the burner unit 280, the heated air is delivered into the tank and dries the goods; the goods are dried of course progressively, and as the pieces of the goods are increasingly dried, they become lighter in weight and are lifted by the air stream to a greater extent, while the wetter and heavier pieces remain closer to the bottom for additional drying. In this progressive drying operation, the dry pieces rise to the top of the tank and are then removed therefrom by novel conveyor means indicated as a whole at 298, this conveyor means including a top conveyor belt 300 which preferably is of highly perforate nature to allow maximum flow of air therethrough. Also the width of this conveyor belt 300 may be substantially less than the diameter of the tank whereby to leave open spaces 302 (FIG. 33) at the sides for air to pass therethrough. The conveyor 300 preferably extends through the walls of the tank, at least at its exit end where a portion 304 is shown in FIG. 28. Under the conveyor 300 a shorter conveyor belt 306 and running in the opposite direction, the two conveyors having adjacent runs moving in the same direction, as indicated by the arrow 308.

The dry pieces are lifted against the top conveyor 300 and are carried along thereby until they encounter the lower conveyor 306 and the two conveyors together grip the goods therebetween and carry them out from the tank through the exit opening 310 where they may for example slide down a stationary slide 312. Preferably a shield or guard 314 (FIGS. 30, 31) is provided, in the form of a flexible apron, mounted on the

exterior of the tank adjacent the outer end of the upper conveyor 300, and over the exit opening 310, this guard serving to confine the goods somewhat on the slide 312. The goods may then drop onto a final exit conveyor 316 to a suitable receptacle.

In the event that an unusually large quantity of wet goods should be introduced into the dryer, and of such great quantity that the air stream from the burner unit 280 should not be able to lift the goods and suspend them in the air, and the goods thus be in danger of being burned, the lever or vane 295 would be moved in clockwise direction, breaking the contact at the switch 294 and shutting off the gas supply, providing a safety factor in this direction.

FIG. 28 also shows outlet air lines 318, having dampers 320 therein, for controllably relieving the air from the interior of the tank, with screens 321 over their inner ends.

FIGS. 32 and 33 show a dryer similar to that represented in FIG. 28 but with a different heating arrangement and including recirculation means. The exit air lines 318 connect with a common manifold 322 which communicates with a burner unit 324 which includes a housing 326. The manifold 322 also communicates with an exhaust air line 328 leading to an exhaust blower 330. At the juncture of the manifold 322, exhaust line 328, and housing 326, is a valve or damper 332 for controlling the distribution of the air in the manifold to the line 328 or the burner unit 324. The burner unit 324 includes a burner 334 firing in an area surrounded by the shell 336 within the housing 326. The housing 326 is provided with an inlet opening 338 preferably at a location around the shell 336, and leading from this area is an air inlet line 340 leading to the blower 282.

The drying operation of this dryer of FIGS. 32, 33, is substantially identical with that of FIG. 28, in this case a portion of the air exhausted from the tank is recirculated with greater efficiency, the amount of recirculation being controlled by the valve 332.

I claim:

1. A washing unit having an entrance tank at an entrance end and an exit tank at an exit end and a flexible tube secured to and between the tanks in sealing relation thereto, whereby wash water therein forms a continuous body from the entrance tank through the flexible tube to the exit tank, the entrance tank being adapted for receiving goods to be laundered in the form of separate and detached pieces, and means external to the tube for flexing the tube for moving the goods from the entrance tank through the water in the tube and to the exit tank, and for agitating the water in the unit.

2. A washing unit according to claim 1 wherein the entrance tank has a bottom opening and the exit tank has a side opening, and the flexible tube has an upwardly directed entrance end opening communicating with the bottom opening in the entrance tank, and a main section extending from the entrance section and extending horizontally and having a horizontally directed open exit end communicating with the side opening in the exit tank.

3. A washing unit according to claim 2 wherein the agitation means includes a plurality of agitators distributed along a substantial portion of the length of the flexible tube whereby to provide agitation of the water

and goods effectively continuously throughout the length of the flexible tube.

4. A washing unit according to claim 2 wherein the agitators produce a wave action on the flexible tube such that the flexing motion progresses linearly along the flexible tube in direction from the entrance end to the exit end, thereby working the goods in the tube therealong in that direction.

5. A washing unit according to claim 3 and including agitators operating continuously as to time and thereby agitating the water and goods also continuously as to time.

6. A washing unit according to claim 5 in which the agitators constitute a series leading from adjacent the entrance end to adjacent the exit end and operating in sequential order from the entrance end toward the exit end, whereby the agitation produced thereby is a wave motion progressing in said direction.

7. A washing unit comprising an entrance receptacle for receiving goods to be washed, and an exit receptacle, a flexible tube interconnecting the receptacles and together with the receptacles forming a chamber for containing water and the goods, and means forming a peristaltic action in the flexible tube for thereby moving goods from the entrance receptacle through the flexible tube and into the exit receptacle.

8. A washing unit according to claim 7 and including a second flexible tube interconnecting the receptacles, and means forming a peristaltic action in the second flexible tube for thereby moving water from the exit receptacle through the second flexible tube and into the entrance receptacle.

9. A washing unit according to claim 1 in which the entrance tank and flexible tube together form a chamber, and in which the unit includes a mechanical pusher in said chamber operative for positively physically initiating movement of the goods in the entrance tank and the adjacent portion of the flexible tube further into the tube at least into the region of a first agitator.

10. A washing unit according to claim 9 wherein the pusher is a reciprocating arm movable between a retracted position effectively out of the tube and positioned in the entrance tank, and in extended position extending into the tube into the region of the first agitator, and first agitator reciprocates between an extended position in which the tube at the region is in full dimension, and a contracted position in which the tube at that region is contracted, and the pusher and first agitator are synchronized in movement so that the pusher is moved into the tube to the region of the first agitator only when that agitator is in extended position and the tube is in full dimension position.

11. A washing unit according to claim 1 and including means for raising the goods and removing them from the exit tank.

12. A washing unit according to claim 11 wherein the means for removing the goods includes a gripper extendible into the tank for gripping the goods and retractable therefrom for releasing the goods onto a conveyor.

13. A washing unit according to claim 11 in which the goods removal means includes a conveyor receiving the goods directly from the flexible tube and carrying them out of the tank.

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14. A washing unit according to claim 13 and including a pressure shield above the conveyor means in the exit tank for cooperating with the conveyor means and thereby aiding in moving the goods along the conveyor means.

15. A washing unit according to claim 11 in which the exit tank has an exit opening and includes means at that opening for controlling the movement of the goods, said goods controlling means including a lower element and upper flexible leaves engaging the lower element and normally forming a seal therebetween against the exit of water, but the leaves being sufficiently resilient to enable goods to be moved between the leaves and the block, and the unit also including means for moving the goods from the bottom of the tank toward the exit opening.

16. A washing unit according to claim 15 wherein the lower element is in the form of a resilient block.

17. A washing unit according to claim 13 and including a mechanical pusher for positively physically moving goods from the exit tank through the exit opening between said leaves and block.

18. A washing unit according to claim 12 in which the gripper means includes three or more levers pivoted together and movable between a mutually closed position in which they are effective for gripping goods between each pair of adjacent levers, and a mutually open position for releasing the goods, and including means for quickly moving them to closed position for correspondingly gripping the quantity of goods, and for slowly opening them in a sequential movement for releasing the goods individually from between successive pairs of adjacent levers for thereby gradually releasing the goods from the gripper means.

19. A washing unit according to claim 18 wherein the gripper means includes an air cylinder operative for

quickly moving the levers to closed position, and is released slowly, a series of progressively stronger to weaker springs are interposed between adjacent levers, and ties interconnect the levers of each adjacent pair.

20. A washing unit according to claim 1 and in which the agitators include cross bars under the tube which support the tube, and crank means for raising and lowering the cross bars and flexing the tube and producing agitation of the water and goods in the tube.

21. A washing unit according to claim 20 and including a linear strip interposed between the cross bars of the agitators and tube, and secured at its ends to a fixed element of the unit.

22. A washing unit according to claim 21 and including means interconnecting the endmost cross bars and fixed elements of the washing unit whereby to confine the movement of those cross bars endwise of the washing unit independently of the strip underlying the tube whereby to relieve that strip of any stress caused by tendency of those end cross bars to drift lengthwise of the washing unit.

23. A washing unit according to claim 1 wherein the flexible tube is disposed generally horizontally, the agitating means including a plurality of agitators distributed along the flexible tube and including cross bars under the flexible tube and reciprocable vertically against the flexible tube for thereby flexing it and agitating the contents therein, the flexible tube having a longitudinal upwardly extending fin, and the unit including means securing the fin to the frame for minimizing lateral displacement of the flexible tube.

24. A washing unit according to claim 23 and including resilient blocks on opposite sides of the fin and interposed between the upper side of the flexible tube and a fixed portion of the washing unit.

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