

Sept. 10, 1968

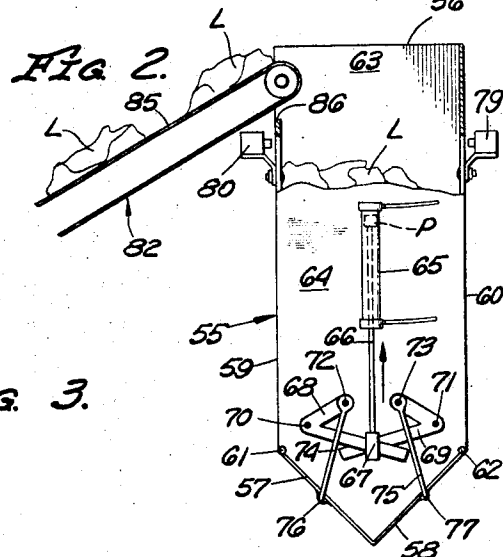
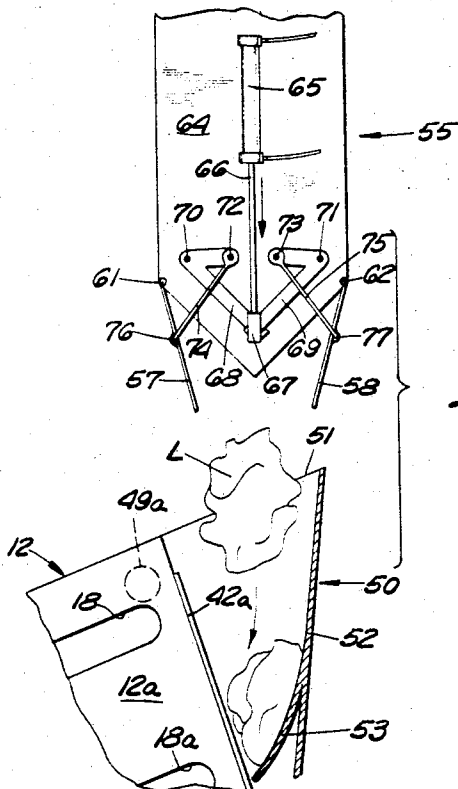
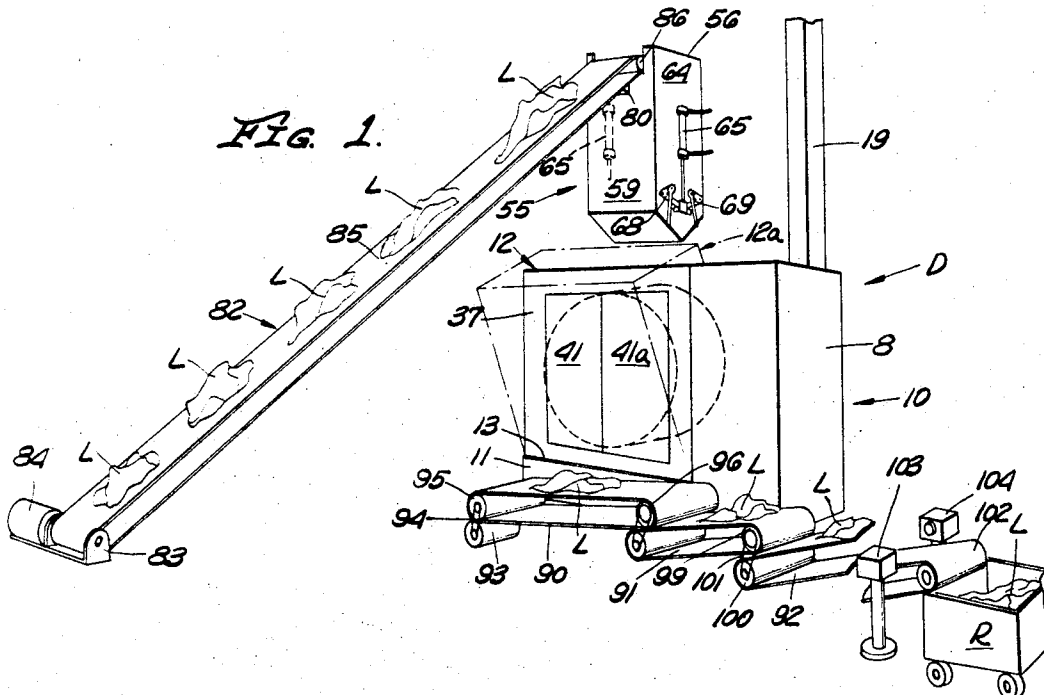
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3,400,467

LAUNDRY PROCESSING ASSEMBLY

Filed April 4, 1967

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 6.

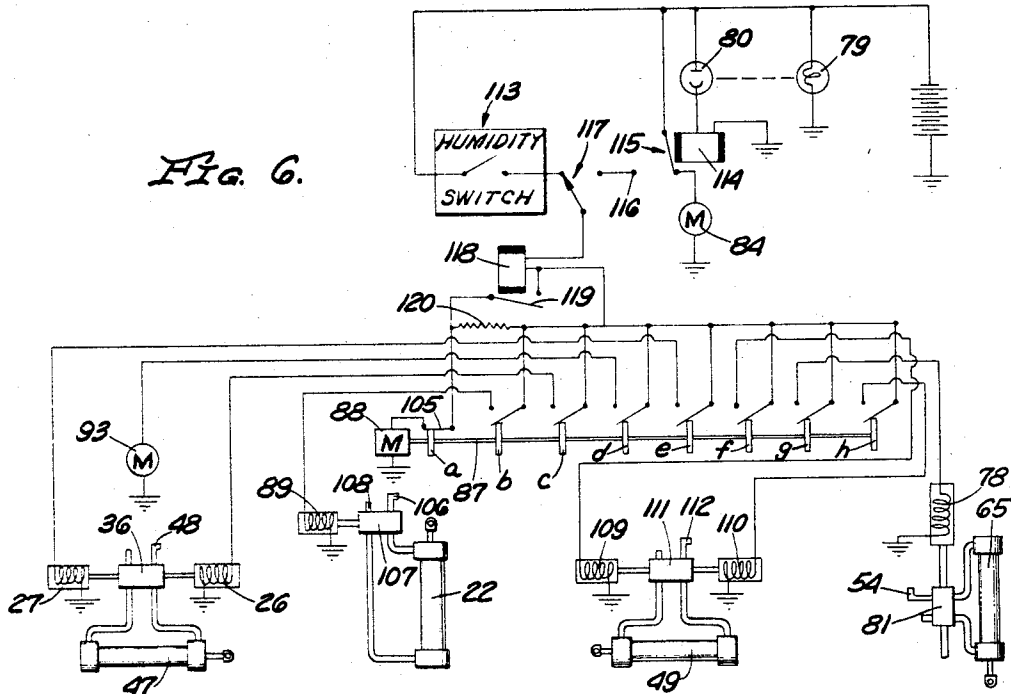


FIG. 4.

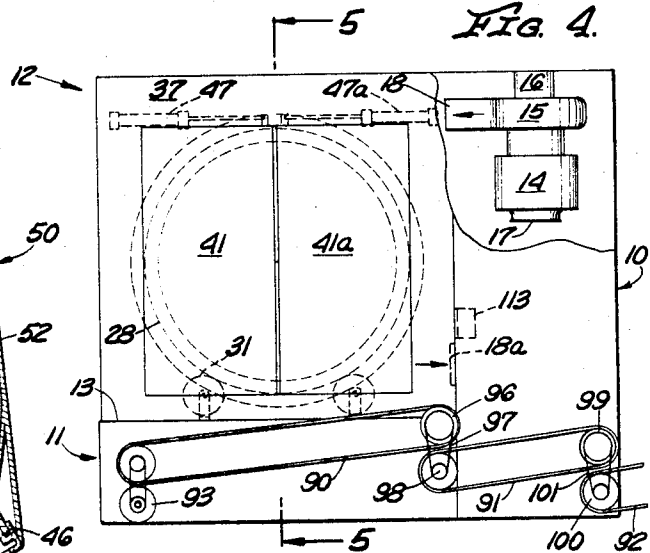
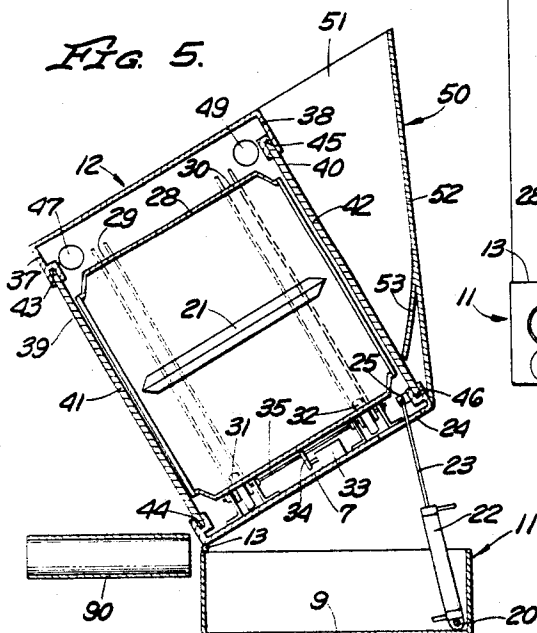


FIG. 5.



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LAUNDRY PROCESSING ASSEMBLY
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14 Claims. (Cl. 34—45)

ABSTRACT OF THE DISCLOSURE

An accumulation hopper has laundry items deposited therein by a continuous conveyer and has a gravity discharge gate located above a washer-or-dryer-carried chute which is mounted to deliver into the entry port of a rotary washer or dryer of the type characterized by a horizontally rotatable, laundry-holding container which is tiltable along the rotation axis for loading into the elevated end discharge from the lower end. Automated control means for sequential operating steps, including pneumatic tilt and front and rear door operation for successive load-unload, are integrated with discharge of the hopper, being responsive to accumulation of hopper-load, or alternately to low humidity determination in the dryer (whichever lasts longer). The discharged load is piece-separated by successively faster-running conveyers and then run past an automatic piece counter.

Background of the invention

This invention relates to an operationally integrated assembly constructed from both old and new units of laundry handling and processing equipment. By the correlated action of successive units, a continuous succession of individual fabric pieces or laundry items, typified by but not limited to a collection of similar sheets or similar towels, can first be accumulated in the present hopper from a continuous-delivery conveyer so as to gather together a predetermined quantity or "charge." Such accumulated amount is then periodically loaded into an aligned processing unit, such as a rotary washer or dryer, and after its processing period it is discharged therefrom to subsequent conveying and counting means. All such units operate in a continuous overall flow of sequentially correlated steps by means of the present timing and control means. Thus, as one load is being processed (i.e., washed and/or dried), the previously ejected load is being automatically separated and counted, while a subsequent load is being accumulated and/or retained in the hopper.

A preferred assembly of the present character is based on use of an axially-tiltable, both-end-apertured, horizontally disposed, rotary washer or dryer which is designed to be loaded at the elevated or uptilted rear end and unloaded at the downtilted front end; the remainder of the time it rotates on an untilted or generally horizontally axis, at a slow speed during charge or discharge, and at an accelerated rate during washing or drying. The operation of the preceding and successive units (e.g. the accumulation hopper and the unload conveyer-separator-counter means respectively) have their control means here correlated with the operating cycle of the rotary washer or tumbler and particularly with its axis-tilt and front and rear door operations for load-unload; such cycle is integrated with the accumulation and load discharge of the hopper, and is triggered selectively by the end of the processing cycle of the rotary unit or by the accumulation of a predetermined load in the hopper. When the rotary unit is a dryer (or includes a dryer at the end of the wash cycle), the cycle which terminates with drying may be monitored by humidity-sensing units which thus trigger the next steps of operation, that is the load discharge from the rotary member and charge of a

new load thereto from the hopper. Alternately, when the hopper-accumulation takes longer than does the rotary processing, a load-sensing device in association with the hopper, serves to trigger successive operational steps of the washer or dryer; such sensing device may be responsive either to volume-accumulation or to weight-accumulation in the hopper.

The invention is particularly illustrated by reference to employment of a conventional rotary dryer or tumbler in the processing assembly. The present rotary dryer is of the type having a horizontally rotatable cage mounted in an axis-tiltable frame or housing for activation in conjunction with pneumatically-operated front and rear doors at each end of cycle, which doors are axially aligned transverse to the tilt axis, so as to facilitate throughput charge and discharge of laundry items when thus slanted. Previously when such dryer was used by itself, that is, with automatic tilting and door operation, but being then manually loaded and unloaded by workmen (two slings per load), a load of wet sheets could be dried in four minutes of actual drying time; but it required more than this amount of time in addition, for the attendants to load and unload each charge. Now by the use of my accumulation hopper, loading chute, discharge conveyer and sequential control means, the daily throughput is more than doubled, and in addition the attendants are completely eliminated. Thus, the same dryer which will put through 10,000 sheets in an 8-hour period, after its integration with my added units can dry 24,000 sheets in the same period. Comparable savings may be effected by automated loading and unloading of tilt-type fore-and-aft throughput washers.

Accordingly it is an object of the invention to provide an accumulation hopper and loading chute which can be easily added to or associated with currently available tilt-type, fore-and-aft load-unload rotary laundry processing units. Similarly an important purpose is to enable the automated integration of such assemblies in a comparatively simple and highly effective manner by use of the present sequential control means. Further advantage is gained by use of the illustrated accumulation-conveyer to supply the hopper and of the unload conveyer, separator and counter units which receive the output from the washer-dryer. Particular versatility is obtained by reason of the present sensor-triggering device being responsive to either a predetermined accumulation hopper load, or alternately to the end of rotary processing in the washer-dryer, whichever takes longer. Other objects and advantages will become apparent as the description proceeds.

Description of the drawings

In the drawings which illustrate by way of example, a presently preferred embodiment of my invention which is based on a conventional throughput, tilt-type, rotary tumbler or dryer—

FIGURE 1 is a semi-schematic perspective of one form of my integrated assembly consisting successively of up-slanted loading conveyer, accumulation hopper, tilt-type rotary dryer to which has been added my loading chute, and output conveyer-separator-counter;

FIGURE 2 is a side elevational view, the upper part in vertical section, of the accumulation hopper, particularly showing one of the pneumatically operating cylinders, the photoelectric sensing means for load determination, and the delivery end of the loading conveyer unit;

FIGURE 3 shows in side elevation the discharge gate of the accumulation hopper seen in open position above the loading chute (shown in vertical section) which is mounted external to the rear loading aperture of the dryer (here uptilted);

FIGURE 4 is a front elevational view of the dryer unit and output conveyer-separator (in part), with a portion of the upper right dryer housing broken away to show internal structure, and other internal elements about the rotary drying cage being indicated in phantom;

FIGURE 5 is a vertical sectional view taken through the output conveyer and the uptilted dryer and attached loading chute along the line 5—5 of FIGURE 4;

FIGURE 6 is a schematic diagram of the sequential operating means of the laundry processing unit and of the sensing means which trigger the cycles thereof in response to humidity of the dried load or alternately in response to accumulation of a predetermined load in the accumulation hopper.

Description of the preferred embodiment

The here-illustrated rotary dryer D is formed with a two-piece housing shell or structure consisting of a stationary base or L-shaped component 10 and a rectangular, semi-nested or complementary-shaped component 12. The latter is hingedly secured along its forward margin 13 (FIG. 5) to a horizontally disposed, open-top support base 11 which thus forms one arm of the L. The adjacent, generally perpendicular upstanding arm of the L houses a heating unit 14 (conveniently gas-burning) and a blower 15 which is operated by an electric motor 16 so as to draw air through the heater 14 from an air inlet 17 and propel it laterally into the adjoining dryer compartment 12 through an outlet 18 (FIG. 4). A stack 19 serves as a vent for the gas heater 14. The inner vertical side of the upright housing arm 8 is in juxtaposition with the adjacent side wall 12a of the hinged compartment 12 so as to enable joint circulation of air through the two openings 18, 18a when the tumbler compartment 12 is "untilted" or horizontal.

Pivotally mounted at points 20 along the rear edge of the floor 9 of base 11 (FIG. 5) are a number of upstanding, fluid-activated or pneumatic cylinders 22, each housing a piston with a projecting rod 23 distally inserted through an opening 24 in the underface 7 of the dryer compartment 12 and pivotally coupled to an attachment bracket 25 therein. By means of two or more of these pneumatic cylinders, the dryer compartment 12 is thus raised from its rest position for intervals of loading and unloading of the rotary tumbler as detailed hereafter. Upon release of air pressure in the cylinders, the dryer returns gravitationally to a level resting, or operating, position. A similar result could be effected of course by lowering the front edge of the housing 12 instead of elevating the rear; or the frame 12 could be pivoted on a transverse axis intermediate its front and rear.

Generally centered within the dryer compartment 12 is a barrel-shaped open-ended cage or tumbler 28 formed with a pair of peripherally encircling tracks 29, 30 along which corresponding drive rollers 31, 32 rotate the cage, being driven by an operating motor 33 by way of sprocket chain 34 and drive shaft 35. The encircling, generally cylindrical wall of the rotary dryer 28 is formed of open mesh or screen material in order to permit free circulation of air therethrough, and may be internally provided with the usual longitudinal lifting ribs 21. It will be appreciated, of course, that when the laundry treating unit is a washer (rather than solely a dryer) the rotary container 28 will be a closed drum with connections for water and suitable sealing means, rather than an open cage; some current units function as both washers and dryers.

The upright, fore 37 and rear 38 faces of the tiltable housing 12 are formed with apertures 39, 40, mutually aligned for insertion and discharge of laundry along the tilt axis or throughput axis of rotation. Each aperture is provided with a pair of laterally slidable closures—front 41, 41a and rear 42, 42a—located in corresponding slideways 43, 44, 45, 46 (FIG. 5). Each pair of doors is operated by a corresponding pair of pneumatic, or fluid, cylinders—front 47, 47a, rear 49, 49a.

By the present construction, an open-top chute 50 is attached to the rear face 38 of the dryer housing 12, being essentially of a trio of upright sides 51 and a downward, inwardly converging, slanted rear wall 52, with a terminal, generally bowed apron 53 which forms a final slide-way for laundry items L to enter the tumbler cage 28 through the rear aperture 40 (when slanted). That is, with the dryer compartment 12 being raised angularly by the lift cylinders 22, and the front doors 41, 41a closed and the rear doors 42, 42a open, a load of laundry entering from the chute 50 will slide forward inside the cage 28 aided by continued slow rotation of the cage by motor 33, so that the container 28 can be rapidly charged with one gravitationally moved load.

When the dryer unit is thus upslanted, it will be seen that the open top of chute 50 is located directly beneath an accumulation hopper 55. The latter is conveniently of rectangular configuration with an open top or entry mouth 56 and a bottom discharge gate formed of a pair of angularly disposed closure members 57, 58 hingedly connected to opposite side walls 59, 60 of the hopper at 61, 62. On each outer face of the other pair of upright side walls 63, 64 is mounted a fluid, or pneumatic, cylinder 65 housing a piston P and projecting piston rod 66 extending downward to a yoke 67 which slidably embraces one arm each of a pair of bifurcate, operating levers 68, 69. These levers are pivotally mounted on the hopper wall 64 at 70, 71, with their upper arms hingedly connected at 72, 73 to a dependent rod 74, 75, which terminally attaches the respective gate walls 57, 58 to their respective bearing ears 76, 77.

It will be seen that downward movement of the piston rod 66 (from the closed position shown in FIG. 2) will open the two members 57, 58 of the discharge gate, with the resulting gravitational drop-out of the laundry items L which have accumulated within the hopper. Sensing means are provided for automatically dumping the hopper contents upon accumulation of a predetermined load, in the illustrated case the load being measured by volume and sensed by means of a photoelectric unit consisting of light source 79 and transversely aligned, light responsive element 80 such as a selenium cell. The unit can be adjusted vertically along the hopper walls for presetting so as to monitor different desired volumes (or determine the optimum one). Such volume adjustment is generally preferred to making the discharge gate responsive to a predetermined weight of laundry accumulated within the hopper, since in most cases the laundry has already been previously weighed, and is moving along in batches. In any event, the sensing means employed acts to trigger the operating cylinders 65 (subject to the qualifications hereafter noted).

Thus while the hopper 55 may often have a whole load or charge inserted into it substantially at once, and thus serve as a storage chamber until its subsequent discharge, it is also useful for continuous piece-by-piece loading, especially when this does not last longer than the operating period of the processing container 28. Accordingly there is provided an upwardly inclined, endless belt conveyer 82 having its lower end anchored to a mounting bracket 83 which also supports a drive source such as the electric motor 84. The laundry supporting surface or face 85 of the belt is roughened so as to provide a non-skid contact with items L even when they are wet enough for water to run off. The upper end of the conveyer is secured in an edge-recess 86 of the side wall 59 so as to allow the belt 85 to drop successive items L into the entry mouth 56. Operation of the conveyer 85 is discontinued during the brief interval that the hopper discharge gates 57, 58 is open, and also when the preset load has been accumulated and is awaiting the end of a longer operating period of the container 28. Thus, in either event, by motor 84 being stopped, the conveyer ceases to add to the accumulation in the hopper when the required quota of the latter has been realized. In

general, when the unit D is a dryer, the laundry items L which are carried by the conveyer 82 are coming from a washer (not shown); when unit D is a washer, the items L are coming from a sorting or staging area.

Conveyer means are also provided adjacent the outlet aperture 39 of the rotary unit, which unload conveyer also acts to separate the processed load into its individual components, that is spaced apart, so they can be passed by an automatic counter and/or be individually ironed, folded, and/or wrapped by means of subsequent handling units (not shown). A longitudinal series of endless belt units 90, 91, 92 placed end to end is operated by an initial drive motor 93 by way of a sprocket drive 94 to a primary roller 95. A relatively large shaft of the next idler 96 is coupled by the drive chain 97 to the smaller axle 98 of the next conveyer 91, so that the latter is driven at a faster speed than that of the first conveyer 90. A similar increased-gearage arrangement accelerates the rate of movement of the third conveyer from the slower rate of the "idler" 99 which is transferred by chain drive 101 to the next "drive" roller 100 (FIG. 4). At each such intersection between adjacent belts, individual items L are separated linearly from each other until they are carried past a light source 103 and a transversely aligned photoelectric cell 104 which operates a solenoid relay to an automatic counter (not shown). As here depicted, the separated items L are then transferred by a last conveyer 92 to a receptacle, here typified by a wheeled cart R, or the conveyer may be directed to a folding or ironing unit, or to a storage bin or shelf. While for simplicity of illustration, the number of conveyers 90, 91, 92 in the series is shown as three, it is preferred to have a minimum of about six conveyers to separate individual items for counting. This is particularly useful when all items in a batch are the same kind, e.g. towels or sheets. However, counting or piece separation is not always required at this point, in which case a single conveyer may be sufficient to take the discharge flow to the next operating station.

Operation

Sequential operation of the various procedural steps or mechanisms is governed in large part by an adjustable timer unit containing an electric motor 88 (FIG. 6) having a projecting, rotary shaft 87 which carries a bank of individually adjustable contact cams *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, each of which by a high point on the cam periphery is disposed to close a microswitch in a particular circuit.

In succession: Contact cam *b* activates the pneumatic housing jack or tilt cylinder 22, by way of a solenoid 89 which opens the high pressure fluid line 106 and closes the exhaust line 108 by means of the plunger valve 107. The various air supply lines here shown are connected, as by a manifold, to a conventional compressed air pump or other source of fluid pressure (not shown).

The next cam *c* activates the pneumatic cylinders 47, 47a which open the laterally-sliding front doors 41, 41a by means of the solenoid 26; cam *e* activates the opposing, valve-closing solenoid 27, both of which operate the plunger valve 36 which is located across the compressed air line 48.

Cam *d* activates the drive motor 93 for the battery of unload conveyers 90, 91, 92, which receive the load discharged through the opened doors 41, 41a. Cams *f* and *h* similarly activate the opening 109 and closing 110 solenoids for the plunger valve 111 on the high pressure line 112 which thus operates the rear doors 42, 42a.

Intermediate cam *g* by means of the solenoid 78 operates the plunger valve 81 in the fluid supply line 54 to the operating cylinder 65 of the hopper discharge gates 57, 58. At the end of the cycle a cam *a* momentarily opens the switch 105 which breaks the circuit to the timer motor 88 and thereby stops it.

As already noted, the sequential steps of the operating cycle of the laundry processing unit which are con-

trolled by the electric motor and contact cams, are initiated either by the increasing accumulation of items L in hopper 55 reaching the preset quota, or else by a longer-required operating period of the processing unit running its course. In the detailed example of the laundry processing unit being a dryer D, the terminating or desired dryness of the load can be measured by its humidity (or by the humidity of the immediate environment), so that the electrical triggering of a subsequent operating cycle is convenient effected by a humidistat or low-humidity-responsive switch, located preferably in the return air current after it has contact the laundry. One such humidity switch mechanism, which compares the humidity of the exhaust current with that of the external atmosphere, is shown for example in U.S. Patent 3,269,027. Another type is based on photocell response to humidity-occasioned color-change of a chemical sensor such as cobalt chloride (3,116,982). Still another type of humidity-sensor measures the electrical resistance of the laundry items by means of sensing bars mounted inside the rotary cage 28. The resistance of the fabric items varies with their moisture content and thus in effect the sensing bar indicates the degree of dryness of the laundry items. A semiconductor device operates a switch when the applied voltage reaches a predetermined value. A diode is biased to correspond to a desired value of dryness; when the fabric resistance reaches this (variable) value, additional voltage is applied to switch the diode to its conducting state and thus operate a relay. Such a "Direct Sensing Moisture Control" (#550-001) is produced by the T. L. Smith Co., of Milwaukee, Wis.

Looking at the upper portion of FIGURE 6, when the beam of light between the lamp 79 and photoelectric cell 80 is interrupted more than transiently, the relay 114 which had been activating the loading conveyer motor 84, is deactivated and the switch 115 shifts to the contact 116. Depending on the set position of the selector switch 117, this movement of the switch 115, or alternately the action of the humidity sensor switch 113, operates the relay 118 to close the switch 119 and thus start the timer motor 88 (with its consecutive cams *b* through *h*, and *a*). 120 is a current limiting resistor.

For example, a load of sheets will dry in the illustrated dryer D in equal or less time than it ordinarily takes to accumulate another load in the hopper 55. Hence the end of cycle will be determined by the switch 117 being first manually turned to the right; that is, the humidity switch 113 or humidity monitoring means will not be in the control circuit. The end of cycle will then be triggered by the photoelectric unit 79, 80, signalling accumulation of the next predetermined (volume) load in the hopper 55. However, drying a load of Turkish towels takes longer than does accumulation of a subsequent charge in the hopper. Hence such completed quota is held in the hopper until the rotating load in 28 is dry; upon activation of switch 115 by relay 114, the conveyer motor 84 stops further delivery to the hopper. The switch 117 having been initially set to its left position, the end of cycle is then initiated by closing of the humidity switch 113 in response to the dryness achieved by the load in the rotary container 28.

It will be understood that the operating motor 33 drives the rotary container 28 at a comparatively high speed during wash or dry operations, and at a relatively slow speed during periods of load and unload. This is a conventional feature found in current laundry models (e.g., U.S. Patent 2,906,035), and need not be further detailed. Likewise, when the rotary container 28 is used primarily in wash operations, its drive motor and necessary water lines and valves will be associated with known timing sequences and circuitry of their own for successive filling, draining, etc., which sequencing operate during the "functional" period between loading and unloading of the processing container 28. In comparison, the present invention provides associated structural units at both ends of a conventional washer or dryer, plus con-

trol means to integrate the sequential operations of these added units with the (previously manually-attended) load-unload periods of fore-and-aft throughput, tiltable, rotary-axis type laundry units in order further to automate their operation. Thus, when my elements are integrated with a present washer instead of a dryer D, the switch 113 is merely made responsive to termination of the spin-dry period which follows the customary wash and rinse, instead of being connected to a humidity sensor. Accordingly, various changes of detail, operation, and adaptation of added elements can be made to accommodate various existing laundry processing units within the scope of the following claims, which are to be interpreted broadly.

I claim:

1. Apparatus of the character described, comprising in combination:

a laundry processing unit including a supporting structure bearing a rotary laundry container apertured at both ends, which ends are disposed along a generally horizontal axis of rotation which is selectively tiltable by relative elevation of the rear end;

front and rear closure means for the respective ends of the container, and operative means for selectively disposing said rotary container angularly by vertically tilting said axis, including means for separately opening and closing the respective front and rear closure means when said axis is tilted, and for operationally rotating said container, whereby in tilted position the rotary container can have laundry items charged thereto through the elevated and open rear end and alternately discharged therefrom through the open front lowered end at the beginning and end of an operating period of horizontal rotation of the rotary container;

a generally upstanding accumulation hopper having a discharge gate located in position to discharge a load of laundry items into the open rear end of said rotary container when the latter is tilted;

sequential operating and control means for effecting an operating cycle of said processing unit by transiently tilting said axis, operating said front closure means for discharge of a present load from the rotary container, operating said rear closure means for charge of a subsequent load to the rotary container, and for rotational operation of the loaded rotary container for a processing period; and

sensing means responsive to completion of processing of a present load in the rotary container or to hopper-accumulation of a subsequent load (whichever lasts longer) for terminating said processing period and initiating another operating cycle of said control means, including tilting said axis, opening the front closure means, discharging said present load, and closing said front closure means, opening said rear closure means, opening said discharge gate and charging an accumulated load from said hopper into said rotary container, closing said rear closure means and untilting said axis.

2. The apparatus of the preceding claim 1, wherein said laundry processing unit is a dryer, and said sensing means includes humidity monitoring means located in the vicinity of said rotary container, whereby the completion of processing is determined by the desired dryness of the load in said rotary container.

3. The apparatus of the preceding claim 1 wherein said sensing means includes a photoelectric unit responsive to accumulation of a predetermined load in said accumulation hopper.

4. The apparatus of the preceding claim 1 which additionally includes conveyer means disposed to deliver a succession of laundry items to said accumulation hopper, and means responsive to accumulation of a predetermined load therein, for halting further additions to such

accumulation by the conveyer until the hopper is discharged.

5. The apparatus of the preceding claim 1 which additionally includes conveyer means located adjacent said front closure means and adapted to receive and progressively separate the discharged laundry items therefrom, and automatic counter means located adjacent said conveyer means in position to count successive individual items thus separated.

6. The apparatus of the preceding claim 5 wherein said conveyer means comprises a longitudinally aligned series of endless belts having interconnected drive means of successively increased gearage, whereby each belt is moved at a faster speed than the immediately preceding one.

7. The apparatus of the preceding claim 1 wherein said laundry processing unit is a dryer comprising a housing with heating and circulating means contained therein, and said rotary container is essentially a cage disposed within said housing, through which cage heated air is moved by said circulating means.

8. The apparatus of the preceding claim 1 wherein said sequential operating and control means include a timer motor, a rotary shaft driven by said timer motor, and a plurality of individually adjustable contact cams carried by said shaft in position to activate respective fluid means which are effective to tilt and untilt said axis, to operate said front and rear closure means, and to operate the discharge gate of said accumulation hopper.

9. The apparatus of the preceding claim 1 which additionally includes conveyer means disposed to deliver a succession of laundry items to said accumulation hopper, and means responsive to accumulation of a predetermined load therein, for halting further additions to said accumulation by the conveyer until the hopper is discharged,

and said laundry processing unit is a dryer comprising a housing with heating and circulating means contained therein, and said rotary container is essentially a cage disposed within said housing, through which cage heated air is moved by said circulating means, and said sensing means comprise humidity responsive means disposed in the vicinity of said rotary container, whereby the completion of processing is determined by the dryness of the load in said rotary container.

10. In combination with a laundry processing unit characterized by a rotary container apertured at both ends and rotationally disposed on a normally horizontal axis by a supporting structure and having axially aligned front and rear closure means providing access to respective ends of said container, and means for rotating said container and for transiently tilting said axis vertically and for operating said closure means when thus tilted for discharging laundry from the lowered front aperture of said container and charging laundry into the container through the elevated rear aperture:

a loading chute located in position to charge laundry through the rear aperture of said rotary container when the latter is tilted;

generally upstanding hopper means having an upper entry mouth and a dependent discharge gate located in position to discharge into said chute when the latter is functionally aligned with said elevated rear aperture;

and sequential control means adapted (a) to tilt said axis, (b) to operate the front closure means for discharge of said rotary container, (c) to operate the rear closure means and discharge a load from said hopper means into said rotary container through said chute, and (d) to untilt said axis.

11. The combination of the preceding claim 10 wherein said sequential control means are triggered by sensing means responsive selectively to completion of processing of a present load of laundry in said rotary container or

to accumulation of a subsequent load in said hopper means:

12. The combination of the preceding claim 10 wherein said loading chute is carried by said supporting structure and moved to functional position by said tilting of the axis. 5

13. The combination of the preceding claim 10 wherein said hopper means are associated with load-determining means adapted to actuate said discharge gate subsequent to accumulation of a predetermined load. 10

14. The combination of the preceding claim 13 which additionally includes conveyer means adapted to deliver laundry items to said hopper means, and associated means adapted to inactivate said conveyer means in response to accumulation of a predetermined load in said hopper 15

means as determined by said load-determining means, until the accumulated load has been discharged into the rotary container.

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